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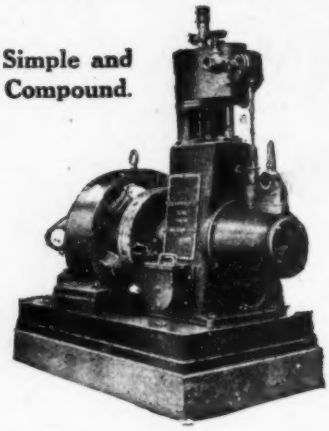

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## TO "ELECTRICAL REVIEW" READERS.

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## THE ELECTRICITY SUPPLY BILL.

THE long-awaited Bill of the Board of Trade has at last been issued, and can be obtained from the usual sources (Bill 72; price 3d. net). For full details we must refer readers to the original text; we give a summary of its contents elsewhere in this issue.

Broadly speaking, the Bill follows the lines laid down by the Committee appointed by the Board of Trade on Electricity Supply, but there are many evidences that the draftsmen have profited by the criticism which has been levelled at the Bill, and by the suggestions which have been put forward from so many sources. We are very pleased to see that no countenance has been given to the egregious proposal that companies which are authorised undertakers shall be deprived of all representation on the electricity boards of their respective districts; that officials who suffer damage through the operation of the Act are guaranteed compensation, though the terms of the clause are capable of improvement; and that the enlarged powers for obtaining compulsory wayleaves without delays, running lines overhead, and using water from rivers and canals, appear to provide the facilities which have so long been needed by the industry.

The Electricity Commissioners are endowed with ample powers, and are entrusted with the discharge of the duties at present fulfilled by the Board of Trade, but their decisions are subject at all times to the approval of the Board, and in many cases they can act only through the medium of a "special order," which, if opposed, involves the holding of a local inquiry, with the consequent delay and expense. As in some cases the Commissioners have to hold local inquiries before issuing the special order, the procedure may be drawn out to considerable length, and affords abundant opportunity for obstruction.

The District Electricity Boards are given very large powers and important duties, with remuneration for their services; the mode of their election is not specified, but their constitution is outlined, and their members will include representatives of all the principal interests concerned, not excepting labour, as well as local authorities which are not supply undertakers, but which agree to afford financial assistance to the Board (with the permission of the L.G.B.)—a new feature in municipal enterprise in this country, though common enough abroad. The function of an Electricity Board is simply stated as the provision of a cheap and abundant supply of electricity within the district, and for that purpose it will be empowered to acquire all generating stations and main transmission lines, to construct new works and lines, and to take over existing undertakings, always subject to the control of the Commissioners. In fact, by the constitution of a district board, all generating stations and main lines *ipso facto* become vested in the board, subject to payment to the owners therefor. In defining the "standard price" provision is made in the case of municipalities, not only for taking over the capital charges in respect of outstanding loans, but also for compensating the owners for capital construction paid for out of revenue, a point upon which the municipal authorities have insisted; in the case of private ownership, the cost of construction and of the site, less depreciation, will determine the amount, subject to arbitration in case of disagreement. What a vista for the Parliamentary Bar! Another municipal point is met by a clause requiring the board to supply electricity to the original owner of a station compulsorily acquired as cheaply as he could have generated it himself.

New stations and extensions of existing stations are made subject to the will of the Commissioners. The rights of existing distributors are expressly protected, provided that

their refusal to allow an Electricity Board to distribute in their areas is not held to be unreasonable. The rights of local authorities to purchase undertakings are transferred to the District Boards—even in the case of County Councils; this clause has a direct bearing upon the future of electricity supply in the London area. District Boards are empowered to delegate or lease their powers to authorised undertakers or to "a company established for the purpose"—a provision at which some municipal authorities, notably in the North-East, will look askance. Pending the establishment of a District Board, the Board of Trade itself may execute the functions of the Board.

The financial provision is of special interest; the Treasury is authorised to provide 20 million pounds out of the Consolidated Fund for the use of the Board of Trade, and may issue Exchequer Bonds for the purpose.

The Commissioners are also authorised to raise an "electricity loans fund" not exceeding 25 millions, out of which to make loans to district boards, the interest being guaranteed by the Treasury. Further, during the first five years, Parliament is to advance money to cover the deficit in the accounts of the Commissioners, other than the loans account, such moneys to be repaid during the three succeeding years.

The principle upon which the Board of Trade is to fix prices for electricity is simple in theory—namely, at such amounts as will cover the capital charges and leave a margin. There is no sanction given to making profits. On the other hand, there is no attempt to impose uniform prices on the whole country—an impracticable scheme. Power is given to suppliers to let for hire and maintain electrical apparatus of all kinds, but not to manufacture or sell them.

The section of the Conspiracy Act of 1875, which deals with breaches of contract by persons employed in the supply of gas or water, is extended to the supply of electricity.

Provision is made, in the event of a Ministry of Ways and Communications being established during the present Session of Parliament, for the transfer of the whole of the powers and duties of the Board of Trade in respect of electricity supply to the new Minister. We have no doubt that the Minister will be as able as the President of the Board of Trade, and as well-disposed towards electricity supply, but it is impossible to suppose that in the stress of organising a new department with enormous responsibilities, he will be able to devote attention to the subject, which must not wait, but is pressing for immediate action.

**The Resettlement Problem.**

A CORRESPONDENT in this issue raises again the question of re-employment of demobilised officers and men, and asks whether preference is given to officers by the Appointments Board. We believe that no such discrimination is exercised; officers and men are dealt with on exactly the same basis, and we know of cases where officers have waited for many weeks before receiving a reply to their application. The fact is that the machinery of the Appointments Board was not ready when hostilities ceased, and it is only now getting into working order. The delay is most regrettable, as there is a great number of men who are unable to obtain either employment or training. The case of men who went straight from school into the Army or Navy is particularly unfortunate and difficult to deal with; some of them, to our knowledge, have been with the Colours practically from the outbreak of war, and are now released at the age of 22 or 23 without any preparation for the battle of life except such as they received at school—we know only too well how much that is worth—and that which they have gained in service. The latter is by no means to be underrated; men who have occupied responsible positions in H.M. Forces have of necessity acquired a more or less sound knowledge of human nature, and many have learnt to handle men; but while this valuable experience will tell in after life, it must be admitted that between handling men under the bonds of military discipline and handling free men under civilian conditions there is a vast difference. Others of less capacity may have gone through the mill without deriving much benefit from the process. We trust that every effort will be made to provide training for those who require it at the earliest possible moment. In the meantime, we wish to draw attention to the remark of our correspondent: "I am too proud to draw the O.W.D. of 29s. per week. How am I expected to live?"

We respect the writer's spirit of independence, but we think he is making a fundamental mistake. He seems to regard the out-of-work donation as savouring of "charity;" it is nothing of the sort. It is an allowance for maintenance to which he is fully entitled, just as if he were still on active service, and is intended to answer his question—"How am I expected to live?" True, it is a meagre allowance in these days of high prices, but that has nothing to do with the fact that, such as it is, it belongs to him and he incurs no dishonour in claiming it.

With the suggestion that employers should make a point of giving demobilised men a chance to prove their worth we cordially agree. At present, in view of the unsettled conditions in the industrial world, we admit that the problem is exceedingly difficult; we are all waiting for the declaration of Peace and the return of stable conditions under which industry can go ahead at full speed. But we hope the moment will not be long deferred, and that our ex-fighting men will speedily come into their own.

**Recent French and American Activities in Spain.**

THE French Minister of Commerce and the Minister of Foreign Affairs have just opened a French commercial bureau at 19, Calle del Principe, Madrid. The object of this new centre is to develop and improve commercial relations between France and Spain. Periodical exhibitions of samples and models will be organised, each exhibition being devoted to the products of a distinct group of manufacturers, or occasionally to the products of a single manufacturer. The bureau will furnish information to French and Spanish manufacturers and buyers on such subjects as tariffs and Customs, transport, conditions of sale, credit, &c.

The *Liberal* newspaper makes the following comment on American activities in Spain:—

**The war is hardly finished and already the Yankees are fixing their attention on Spanish affairs. A representative of the National Bank is now in Madrid studying the question of opening a branch. There is also in Gibraltar a representative of the International Transport Co., who is deeply interested in the proposed new railway from the French frontier to Algeciras. The Americans are studying our railways, our tramways, water-power, mines, &c., and there is no doubt the near future will see a much better commercial understanding between this country and the United States.**

The Spanish technical periodicals now show quite a number of advertisements from French and American houses. The American method of propaganda is to advertise well and to open branch establishments, whereas the French system is to advertise well while conducting business from the central office in France. Our special correspondent in Spain, writing on this subject, says:—"It is possible that British manufacturers are preparing to secure a share of the Spanish market, but up to the present their activities are not mirrored in the technical Press."

**Electricity Supply Regulations.**

THAT the "informal meetings" of the Institution of Electrical Engineers have filled a real want, and proved a successful venture, is, we think, beyond question; their main object is to promote discussion amongst the more retiring members, and this has certainly been achieved, the discussions being both interesting and well sustained. Our compliments are due to the chairmen—Messrs. Rankin and Pooley—for their able and genial conduct of the meetings, which has greatly conduced to their success. The falling-off in the attendance since the first meeting is largely due, we believe, to the inconvenient hour at which the meetings are held; as we stated in our issue of March 21st, several members informed us that they would prefer an earlier start, and on Monday this feeling was voiced by others during the discussion.

Mr. Bradshaw, in opening the debate, devoted most of his remarks to the article by Mr. C. A. Baker, which we published a few weeks ago, and to our comments on the subject. As the article and leader dealt mainly with the legal and commercial aspects of the question, we did not anticipate that they would in any way affect the discussion at the approaching informal meeting, which we expected to turn on technical points. However, they were evidently a godsend to Mr. Bradshaw, whose breezy humour enlivened a subject which in other hands might have proved somewhat dull. The chief points of importance which cropped up in the discussion were the desirability of adopting one uniform set of rules—namely, the Wiring Rules of the I.E.E.—and giving them the sanction of legal authority; and the necessity of introducing the registration of wiremen, in order to put an end to jerry wiring, and to checkmate the incompetent wireman-contractor. With both of these proposals we cordially agree, and we feel sure that everyone who has the interests of the industry and the public welfare at heart will give them his energetic support.

**The I.E.E. Elections.**

In our recent comments on the nominations for the new Council, we anticipated that additional nominations from outside would be submitted; these did not, however, appear on the balloting list. As will be seen from a letter in our "Correspondence" columns, such nominations were sent in, but owing to a technical defect they were invalid.

Our correspondent, who, we believe, represents a considerable body of members, assumes an attitude decidedly hostile to the Council, and evidently feels very much aggrieved. It is certainly very much to be regretted that the nominations were disqualified, but is it quite fair to blame the Council for the mishap? We have in past times had occasion ourselves to criticise various actions and omissions of the Council, but in this case we see no reason to attribute to it any unworthy motive or to jump to the conclusion that the incident has any sinister significance.

It is not many years since the Articles of Association were altered after mature discussion, one of the chief reasons for alteration being the desire of the Council to satisfy the demands of the members for a reformed system of election. Apparently, in spite of the best intentions, a loop-hole for mishap still remains, but evidently it would be easy to avoid a repetition of the trouble on future occasions. That the Council would deliberately flout the wishes of the Associate Members, who constitute the mainstay and more than half the membership of the Institution, is hardly credible, and the record of progressive action and successful work that the Council has to show for the past few years affords no support to the theory. We trust that steps will be taken to convince the writer of the letter and his friends of the *bona fides* of the Council, which we believe would be an easy matter if a personal interview were arranged.

**Labour in the German Cable Industry.**

The chairman of the Deutsche Kabelwerke of Lichtenberg (Berlin), speaking at the recent general meeting, stated that the wages paid in 1918 had experienced a terrible increase. It was a question, in his opinion, whether foreign competitors would not be able to secure the business in the German home market. It was, therefore, necessary for wages and the length of the working day to be fixed by international agreement, whilst syndicates were needed for the inland market. The apprehension that the latter formed the bridge towards socialisation was without any foundation, as undertakings which required the work of individuals were not suitable for socialisation. It would be possible, however, to meet the democratic idea by modifying the German company laws in the direction of reducing the value of the share from 1,000 marks (£50), so as to afford an opportunity to the workmen to acquire shares. If this were done, it would offer the best solution of the question of joint or co-decision, in so far that the possibility for electing workmen as directors would arise. On the other hand, the right of joint control without any participation in the capital could not be conceded. The feeling of responsibility on the part of the workman would be stimulated by his having a financial interest in the undertaking.

## SEVEN YEARS IN EAST ASIA: SOME IMPRESSIONS AND REFLECTIONS.

By Prof. C. A. MIDDLETON SMITH.

During the next 10 years there will be rapid changes in China. Despite the war, there has been extraordinary progress in engineering work in the Far East during the seven years that the writer has been living in that part of the world. Electric light installations are being fixed up, or have been fixed up, in nearly all the towns in China, and even little villages near the treaty ports have 10 and 15-kw. plants. In a tiny little fishing hamlet near Hong-Kong, where law and order is maintained by one British police-sergeant, about a dozen Indians, and a few Chinese constables, where there is hardly a two-storied house, and where about one-half of the people seem to live in structures made out of bamboo poles and matting, electric light is installed. In the matsheds are 5-c.p. lamps, and the charge is 50 cents (say 6d.) a month for such a light, including maintenance. That is just an example, and there are many other signs of the onrush of the engineer in East Asia.

But the purpose of this article is not to give details of recent engineering progress in China, but simply to relate a few general impressions by an engineer. After nearly seven years of work with the Chinese, among whom he is glad to know that he has many personal friends, the writer is shortly coming "home" on leave. That is the custom of the Far East, especially of South China, where the climate is that of a vapour bath, certain to affect the insulation of electrical gear and the livers of the non-Asiatic. And it is hoped just now to record a few impressions in the setting in which they were formed.

### The Genius of Kipling.

When Sir Alfred Ewing, who is now Vice-Chancellor of the University of Edinburgh, wished me "Good luck" on the eve of my departure from London to the Far East, he made two remarks which have frequently come back to my mind since that day. He had been very kindly telling me of his own experiences in Japan, and I had replied that the one thing that worried me was a feeling that in the Far East there would be intellectual isolation in scientific matters. "That is true," he said in effect, "but you will have ever so much more leisure, and so more opportunity for research work." That was an optimistic forecast which was made without any knowledge of the peculiar difficulties in the way of the newly-created University of Hong-Kong. It also, of course, ignored the demands made by the Great War. He added some words like these: "You will have one great advantage in Hong-Kong that I did not have in Japan—you will be under the British flag." That was in 1912; and in my enthusiastic admiration for the Islanders of the Far East, an admiration created by English newspapers and magazine articles about the Anglo-Japanese alliance, I replied that surely there would be very little difference in the conditions which obtain in the countries which fly the flags known as the Rising Sun and the Union Jack. But experience has taught me that there was a great deal of truth in those words of one who had lived in the Far East, for my travels, during the two years before August, 1914, taught me two things. The first is that Kipling was inspired when he wrote "What do they know of England who only England know?" The other is that Japan was not only the land of cherry-blossom and people who are delightful company when met socially, but that it was, perhaps still is, the home of a military party which has made nearly all of the Europeans, and practically all the British merchants in China, anxious about the future. It may not be correct to say that, before August, 1914, the Japanese were anti-British; but they impressed one impartial observer as being definitely anti-American. It is correct to say that they are not popular to-day in China.

The war aroused national feelings in Great Britain which were so intense that they saved the world from disaster. But before the war these feelings existed, and were very much in evidence, in the places where Europeans

congregate in China. They exist to-day; a thing that has impressed me very much is the growth of this feeling among the Chinese. They bitterly resent what they think is the interference, even the aggression, of the Japanese in the affairs of their own country.

The mass of the vast population of China live on the soil, and are very poor, and thus interested only in local affairs. But a new generation in the treaty ports are demanding the development of the natural resources of the country, and they will win. They welcome engineering appliances and scientific knowledge, and they distrust Japan, especially when they think of Korea.

### The Workers and the Drones.

Another thing that has impressed me greatly, is the utter failure in China of an entirely classical education. For many centuries the Chinese clung only to the classics for their learning. "First comes the scholar," says the Chinese sage, as he lists the various types of men, putting the farmer second, the mechanic third, the merchant fourth, and the soldier last of all. It is not for one engaged in academic work to be-little scholarship. But it is important to insist that true scholarship is not the scholarship which was the ideal of the old-time Chinese scholars. Life would be a hopeless sort of a business without the inspiration of good literature; many a man of science has turned from his experiments and his mathematics to be refreshed by the great thoughts to which we, of this generation, have become heirs. But the Chinese scholars learnt classical platitudes, and most of them failed to act according to the precepts about which they prattled. It is useless reading good literature unless it produces good results, and also we must remember that science without the ideals of life, is prostituted and becomes brute materialism. The Germans have made us understand the horrible results of that creed. Therefore, let us insist that we must have developed in our Universities the subjects which we call Arts and Science. The lamp of knowledge must be held aloft—not only must we have it fed by the scientists, but also by the men of letters, the historians, those who think about law, and even the poets. You are not a real Briton if you know nothing about Shakespeare or Drake or Magna Charta. But, also, you are not a true Briton if you are ignorant of the work of James Watt, Faraday, Darwin, and those others of whom some of the clever ignorant people in Britain know nothing. You are like the old mandarins of China, if you have a lofty contempt for the work of the scientist and the engineer. Before the war the writer experienced that sort of contempt—University colleagues and Oxford-trained administrators spoke of an engineer as did the old Admiral of years ago, who called the engineer of the Royal Navy "A lascar with an oil can." But the war has produced a change. There is rather less patronage towards engineers from men of the "learned professions." But, even now, the engineer has not obtained for his profession the status that it deserves.

When a man in his outlook ignores entirely the arts, he is working for the German ideal; when a man ignores entirely in his outlook the sciences, he is working for the Chinese ideal. And, speaking of them collectively, the scholars of China during the last few centuries have been the drones. They had to become classical scholars to become officials; and the officials have been the curse of the country. Conceited, and contemptuous of manual work, a contempt advertised by long finger nails, they have tried to stem the tide of scientific knowledge with a wall of classical learning; and now that the tide is bursting through these artificial barriers, they are bartering their country and its vast natural resources with anyone who will stoop to bribery and corruption. Not all of the Chinese officials—perhaps you can name exceptions. But the spirit expressed by finger nails inches long must be swept away if the rich stores of minerals are to be unearthed, the methods of communication improved, the workers lifted out of beggary and freed from rapine, murder, flood and famine. There are influential Chinese who still advocate only a classical education for the youth of the country; and the answer to their tirades is—China; China, the land of the most industrious people, the land of vast natural resources, the land of chaotic government, flood, famine, and poverty. On the other hand, there are influential men in Europe who sneer at anything that is not "business," and the answer to them is—Germany; Germany the outcast amongst nations, the clever, ignorant rulers of which country have sent a whole people into the Abyss. It is a good thing for Anglo-Saxon engineers to keep in mind the results of two extreme ideals in two countries so far apart. "Virtue is the extreme between two vices," says a Chinese proverb. Engineers should study good literature and the Arts; people certainly should know something of the laws of Nature and Science.

### Early Impressions.

It is nearly a quarter of a century ago that the writer first saw and read the Electrical Review, and over all that long vista of years he has never failed to glance through its pages and to read the articles the ideas of which have appealed to him. The most important portion of any journal is, or should be, what is called "the editorial" or "the leading article." For twenty-five years there has been in the editorial articles of the Review a note which always has rung true; which has often stimulated one reader to take a deeper interest in his work, to be proud of his profession, to take a closer note of those problems which are not entirely technical in their nature. It would be wrong to suggest that the writer regards the Review as infallible; it is far too human for that. But, without in any way losing its value as a technical journal, it has always opened its columns to ideas that do not involve the integral calculus or even a knowledge of workshop practice. It seems to have tried to keep in mind the true purpose of all literature, which is to inspire the reader to accomplish some worthy object. It has always advocated educational development, and it has been invariably sympathetic with the "under dog." Nearly twenty years ago it published an article by "A University Lecturer," entitled "Some Difficulties which Lecturers in Engineering Meet," or words to that effect, for it is impossible to refer to the files of the Review just now. It was written in reply to an article by a student in engineering, who described some of his own difficulties, and a rather weary lecturer who read the student's contribution wanted to put before the Review readers the story of his own trials. To be quite frank, he never expected that the Editors of the Review would "accept" his effort. It was completed, he remembers, after an "all-night sitting"; and for a week he wondered at his own audacity in troubling the Gods of Olympus. But on the following Friday, there it was in print. And now that the editors of the Review are 10,000 miles remote from that writer, and after 20 years, he finds a reversion of that early anxiety. For only a mixture of coercion, by the writer, and an appeal to sentiment, will overcome their modesty and persuade them to publish words of praise for the Review. But the words are well deserved.

### A Friend in Need.

In the year 1912 the writer came to Hong-Kong to a University that had no laboratories, no money, no students, and practically no staff. There were just four of us for that first year. The Principal was Sir Charles Eliot, C.B., K.C.M.G., scholar and administrator, and intellectual giant. He is now on leave, and is acting as British High Commissioner in Siberia. Mr. Matthewman was lecturer in physics, Mr. Hinton was Registrar, and the writer occupied the only chair—the Taikoo chair of engineering. Amateurs had planned the University, and like all amateurs they had under-estimated the cost. There was only one of two things to be done—either to appeal to the sentiment of the British manufacturer and shipowner, or acknowledge failure. We appealed to the technical journals, and in some cases the response was immediate and generous. The Review was true to its traditions. It had the necessary vision. In the days before the war, the writer explained the aggression of the Germans in China, which had been another revelation to him in 1912. Thus did the Review help us. After two years, success became certain. The first batch of graduates went out into the Far East, to carry British ideas and ideals into the arid desert of intellectual China, in 1916. The total roll of graduates (other than honorary graduates) of the University is 71; of these 42 are engineers. The Chinese now believe firmly

in the University of Hong-Kong; but in the beginning they adopted the typically-Chinese tactics of "wait and see." Those of us who believe that only by demonstration and training of young Chinese in engineering work can the vast natural resources of the country be properly developed, cannot forget the splendid support of our friends in the days of doubt and difficulties. Time after time has it been possible to trace new schemes involving the use of machinery in China to a chance visit of the friends of students and others to the laboratories and workshops of the University. If Great Britain were really properly organised for scientific purposes, we should have still further examples of British machinery to show our Oriental students and visitors in the University of Hong-Kong. To paraphrase a well-known proverb, we can almost say that an ounce of machinery at work is worth a ton of text-books in China.

Our engineering students have come from Peking, from Hupeh, Shanghai, Yunan, Singapore, Bangkok, and many other places in the Far East. Those of us who have learnt to know the Chinese well like them very much indeed. They have an immense respect for learning, and they are beginning to see that all knowledge is not bounded by the classics of China. After nearly seven years of work, almost entirely in co-operation with the Chinese, the writer is coming "home" on six months' leave. He wants to persuade British engineers to take an interest in China. He hopes to see that vast country criss-crossed with railways, penetrated by roads, stimulated by everything electrical. He trusts that the British engineer in China will be as respected by the Chinese as those others from "the old country," such as General Gordon, Sir Robert Hart, and Sir Richard Dane. It is time that the British engineering profession and trade should have big ideas about China. In the years that are past, some of our politicians made big bungles; the British policy was feeble and haphazard. There is a rich soil in China; if we sow the seeds with scientific knowledge, and show courage and enterprise, we can do in that country what has been done in India, Egypt, and Mesopotamia. It will never be done unless scientific people give the subject more than a passing thought. They must act. They must even be prepared to sow the seeds, and to wait patiently for the harvest. China is a name that has been too often associated only with the ideas of opium and missionaries. In the engineering profession in Great Britain you have the real missionaries; the men of vision with a practical outlook; the men who, by their work, are transforming the earth, making the desert and jungle fruitful, and utilising the Forces of Nature for the good of man. If they assist in this vast work in China, they will also provide work for the factories of Great Britain. The Chinese have, in the last few years, completely changed their outlook. They now welcome machinery, but they do not know of its uses. The British must show them and help them. My outstanding impression, after seven years in China, is that the opportunity for the British engineer to do splendid work on behalf of humanity was never so great as it is to-day in China. "There is a tide . . ." Shall we let it flow past us? It seems impossible, when we remember the history of engineering in Britain during the last 50 years.

## THE STEVENS PETROL-ELECTRIC VEHICLE.

The Stevens petrol-electric drive has been referred to on several occasions in these pages. We give below a brief account of the capabilities of the 3-ton War Office subsidy Stevens petrol-electric lorry. In this vehicle, fig. 1, as is generally known, the place of the gear box and clutch is taken by a very flexible electric transmission. Its speed and electrical generating capacity especially adapt it for trailing and supplying D.C. for searchlights, for which purpose it has been largely employed both at home and overseas. In addition, the car has special uses in providing an electrical supply for arc welding, electric lighting, heating, and battery charging. In fact, besides being a transport lorry pure and simple, the car is able to provide a supply of electricity wherever it is able to go and without the use of any auxiliary apparatus.

By means of special control, the generator can give a continuous output of 300 or 230 amperes at voltages varying from 80 to 110 respectively, and the characteristic of the machine can be immediately adjusted, so that it will under, level, or over compound, the latter feature being of value when a varying supply at constant pressure at the end of a long cable is required. For battery charging the generator may be used as a shunt machine.

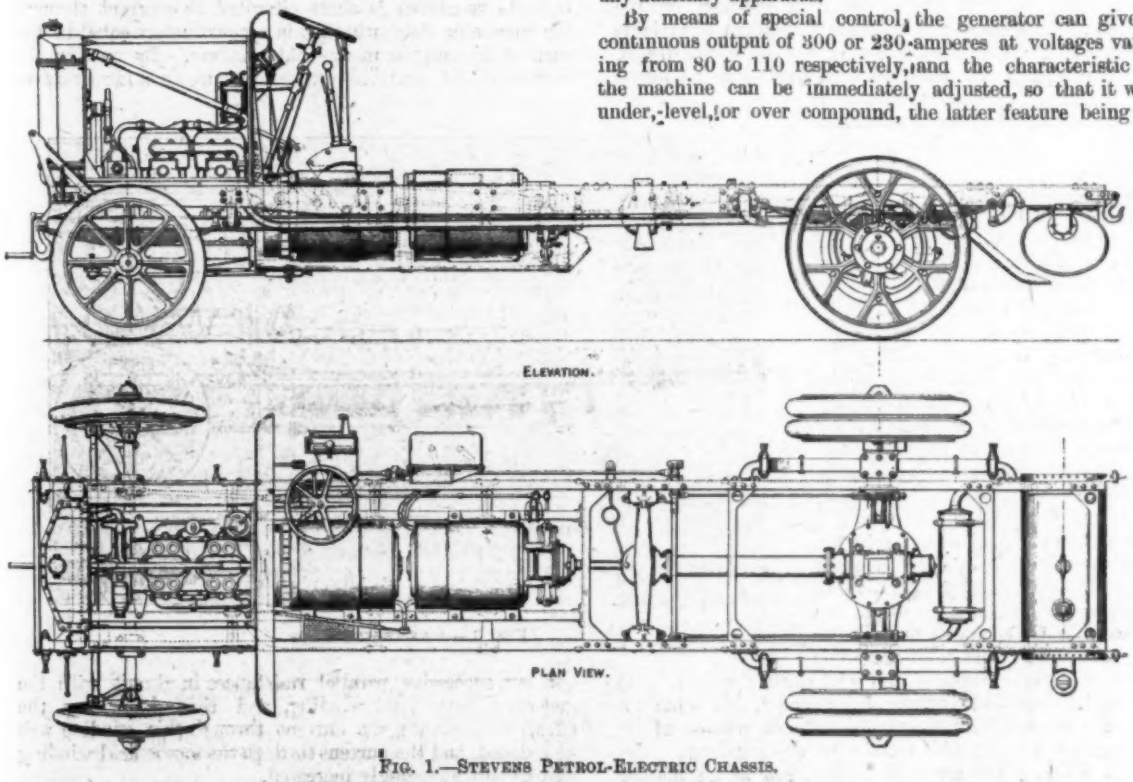


Fig. 1.—Stevens Petrol-Electric Chassis.

The electrical generator, of the four-pole interpolar type,

is compound-wound and provided with commutating poles. It is direct coupled by means of a flexible coupling to the petrol engine, which is fitted with a centrifugal governor, adjustable as to speed by a hand-wheel on the middle of the dashboard.

The shunt winding, of high resistance, in series with a multiple contact resistance, is connected directly across the brushes of the generator for lighting purposes, and across the brushes of the motor for driving purposes, the change over being effected by the switch L D (see fig. 2), and is capable of exciting the field to produce the required E.M.F. when no current is being supplied to the outer circuit.

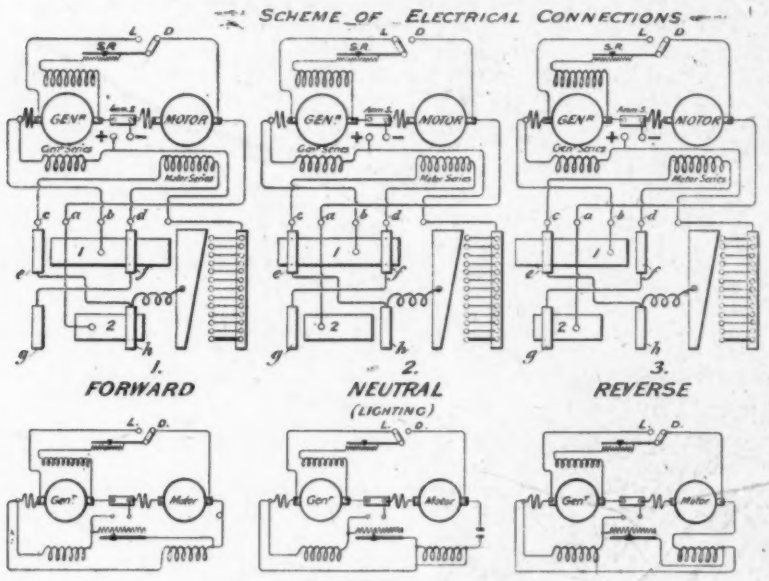


Fig. 2.—Electrical Connections.

From the positive brush of the generator the circuit, after passing through the interpole windings, divides, one circuit being through the series field winding of the generator. This circuit is continued through a variable resistance to the movable contact of the resistance device, which in turn is connected to one terminal of the motor field winding. The other circuit is taken to one, say, *b* of two intermediate terminals *a* and *b* of the reversing controller.

The electrical connections of the reversing controller are as follows:—Carried by, but insulated from, the controller spindle, and from each other, are two plain conducting movable segments, numbered 1 and 2, fig. 2. These are arranged concentrically with, and symmetrically to, either side of the spindle when the latter is in its mid position. The segment 1 extends through an angular width of about 210°, and segment 2 through an angular width of about 150°. Mounted on an insulating base or carrier are four stationary contacts *e*, *f*, *g*, and *h*, of which *e* is connected to terminal *c* and *f* to terminal *d*. Contact *e* is so arranged that it can make contact with the left-hand-side portion of segment 1, and contact *f* is so arranged that it can make contact with the right-hand-side portion of the same segment, and contact *g* can make contact with the left-hand-side portion of segment 2, and contact *h* can make contact with the right-hand-side portion of the said segment 2 by suitable rotation of the segments. The contacts *e* and *g* are arranged in line, and at an angular distance of about 180° from contacts *f* and *h*, which are also arranged in line with each other, the contacts being cross-connected, so that contacts *e* and *h* are electrically connected, as also are contacts *f* and *g*. Segment 1 is flexibly connected to terminal *b*, and segment 2 is flexibly connected to terminal *a*, which is connected to the negative brush of the motor. Terminal *d* is connected to one end of the motor field series winding, and terminal *c* is connected to the other end of such winding and to the movable contact of the resistance device. This device comprises a number of resistances adapted to be successively connected in parallel with one another by movement of the said movable contact in one direction, and a short-circuiting contact.

When the spindle of the controller is in its mid or neutral position, as shown in diagram 2 (fig. 2), segment 1 electrically connects contacts *e* and *f*, but segment 2 does not connect *e* and *d*, as there is an interval of about 15° between its ends and the centre lines of the contacts.

By means of this controller it will be seen that the series field winding of the electric motor is connected across the terminals of the reversing controller, the negative brush of the motor being connected to the intermediate terminal *a*. The circuit from the positive brush of the motor to the negative brush of the generator is made by a low-resistance conductor.

The switch connections are such that in the "forward" position of the controller, diagram 1 (fig. 2), the series winding of the generator with its series resistance forms a variable shunt to the series field of the motor and the direction of current through the motor series field winding and armature causes the vehicle to be driven in a forward direction. The generator series field winding is connected through the variable resistance to the terminal *c* of the motor series field winding.

The generator series field winding and the motor series field winding are thus connected in parallel, and when the variable resistance is short circuited, the current through the generator field winding is approximately equal to the current through the motor-field winding. By moving the contact of the variable-resistance device in a direction to cut out successive parallel resistances in circuit with the generator series field winding, and thus increasing the effective resistance, the current through this winding will be reduced, and the current through the motor field winding will be correspondingly increased.

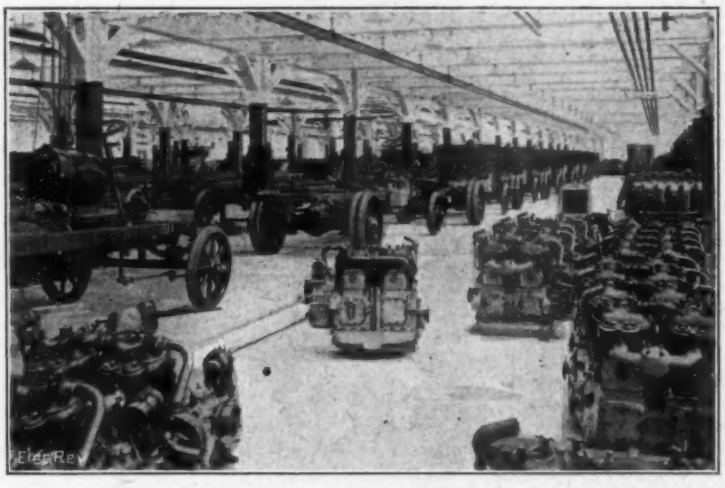

Fig. 3.—Assembling Shop.

When the last fixed contact of the variable-resistance device has been reached and passed, and the circuit of the generator finally broken, all the current from the generator will pass through the motor series field winding. By the

arrangement described, a large speed variation between the generator and motor is obtained.

When the controller is put into the reverse position, diagram 3 (fig. 2), the generator series field winding is connected in series with the motor series field winding, and can also be shunted by a circuit of low resistance in the controller. As the resistance of the generator field winding is also low, sufficient current will then pass through the latter winding to well excite the generator, the shunt field winding of the generator also assisting. The vehicle will then run in a reverse direction.

To use the electric generator for lighting or welding purposes, it is necessary to put the reversing controller into the middle or neutral position, diagram 2 (fig. 2). The connection between the motor armature and its series field winding will then be broken, and the motor series field winding and the generator series field winding, with the variable resistance, will be short-circuited.

As one of the lighting terminals is connected to the junction of the generator and motor armatures, and the other to the junction of the generator series field winding and the variable resistance, this resistance can be made to act as a variable shunt to the generator series winding, so that any desired excitation can be attained, and the machine can be used either as an under, level, or over-compounded generator at any voltage between 80 and 110.

Fig. 4.—Stevens Lorry used for Arc Welding.

Last week we had the pleasure of being present at the works of Messrs. Dennis Bros., Ltd., Guildford, and witnessed a most interesting demonstration of the capabilities of a 3-ton lorry in supplying electricity for arc welding. The equipment used was that supplied by the Quasi-Arc Welding Co., Ltd., and the only requisites beyond the lorry itself were electrodes, a holder for them, and a patent reactance coil in each welding circuit. A 3-ton wagon is capable of dealing with three welding equipments at 60 volts, or two at 105 volts, fig. 4, and the results achieved are certainly very satisfactory.

The running capabilities of the vehicle were also demonstrated in the hilly district surrounding Guildford, and we were able to see the manufacture of the vehicles, which is carried out on the lines of the Ford system. As will be seen from fig. 3, the frames are moved along from point to point as they are assembled, and finally emerge under their own power. Each frame is moved along about once every $1\frac{3}{4}$ hours, and a vehicle is completed in about two days.

These vehicles appear to be capable of very creditable performances, and their ability to serve more than one purpose deserves emphasis.

In conclusion, we have to thank Mr. W. A. Stevens for supplying the particulars set out above, and for the courteous manner in which we were received by Messrs. Dennis at the time of our visit.

## NATIONAL ELECTRICITY SUPPLY.

The following is a summary of the "Electricity (Supply) Bill" that was introduced into the House of Commons by the Home Secretary on Thursday, May 8th:—

The Bill provides that for promoting, regulating, and supervising the supply of electricity there shall be established as soon as may be after the passing of this Act, a body to be called the Electricity Commissioners, who shall have such powers and duties as are conferred on them by or under this Act, and shall act under the directions of the Board of Trade. The Commissioners, not exceeding five in number, of whom one shall be chairman, shall be appointed by the Board of Trade; in the case of two of the Commissioners the term of office shall be fixed by the Board of Trade at the time when the appointment is made; the other Commissioners shall hold office during His Majesty's pleasure.

The Electricity Commissioners may appoint a secretary and a staff of inspectors, officers, and servants; a fund will be established out of which they and their staff will be paid and on retirement awarded pensions at rates determined by the Board of Trade, and any expenses incurred by the Commissioners will be defrayed.

The Board of Trade may exercise through the Electricity Commissioners any of their powers and duties under the Electric Lighting Acts or the orders made thereunder, or under any local Acts relating to the supply of electricity.

The Commissioners may, subject to the approval of the Board of Trade, conduct experiments for the improvement of the methods of electric supply and incur the necessary expenditure, and may appoint an advisory committee to assist them.

The Electricity Commissioners may, after holding local inquiries, by special orders create districts for the purposes of the Act, and constitute and incorporate for each such district a district electricity board, including representatives of local authorities, companies, and authorised undertakers within the district, large consumers of electricity, and labour.

Any such order may provide for the appointment by the Commissioners of a person experienced in the control of large industrial undertakings as chairman of the board, and for the remuneration of the members.

It shall be the duty of every district electricity board to provide a cheap and abundant supply of electricity within its district, and for that purpose every such board shall have such powers with respect to the acquisition and construction of generating stations and main transmission lines, the supply of electricity, and the acquisition of the undertakings of authorised contributors and power companies as are hereinafter mentioned, and every board shall comply with any directions given to them by the Commissioners.

As from dates specified in the order constituting a district electricity board, all generating stations then existing within the district, other than private generating stations, and such main transmission lines as may be specified, shall vest in the district electricity board, subject to the payment to the owners thereof of the standard price.

Any particular generating station unsuitable for the purposes of the undertaking may be exempted by the Commissioners.

The standard price in the case of plant belonging to a local authority shall be annuities required to indemnify the local authority against their liabilities for interest and sinking-fund charges on outstanding loans; if a substantial part of the cost has been defrayed out of revenue, such annuity may be increased by such amount as the Commissioners think just.

In the case of plant belonging to a company or person, the price shall be the cost of construction of the plant and the acquisition of the site, less depreciation.

If in any exceptional case it is shown that the procedure would work injustice, the matter shall be determined by an arbitrator appointed by the Board of Trade.

A district electricity board may, with the consent of the Commissioners, acquire any private generating station on such terms as may be agreed.

Whenever a district electricity board acquire a generating station otherwise than by agreement they must supply the former owner with electricity at a price not greater than that at which it could have been generated, with due regard to the existing circumstances.

Where a station or line has been vested in or acquired by a district electricity board the board may, subject to the approval of the Commissioners, authorise the former owner to work it on behalf of the board.

Where a district electricity board are authorised by order to acquire or use any land for the purpose of a generating station, no person shall be entitled to restrain the use of the land for that purpose.

No person except a district electricity board may establish a new or extend an existing generating station without the consent of the Commissioners unless it be a private generating station, and the owner complies with regulations made by the Commissioners as to the type of current, frequency, and pressure to be used.

A district electricity board shall not supply electricity in any area which forms part of the area of supply of any authorised distributors without the consent of those distributors, except to lighting authorities, or for traction, or in the area of supply of a power company, without the consent of the company. If the consent is unreasonably withheld, the Board of Trade on the recommendation of the Commissioners may dispense with such consent.

The Commissioners may impose on any district electricity board an obligation to supply electricity in such circumstances, within such areas, and on such terms and conditions as to price and otherwise, as may be specified.

Any right to purchase an undertaking vested in any local authority will be transferred to and vested in the district electricity board.

The Commissioners may on the application of a district electricity board by order exclude from the area of supply of any power company any part of that area which at the time of the application is not being supplied by the company, and in consideration therefor may confer on the power company power to supply electricity for lighting purposes in other parts of their area of supply which do not at the time form part of the area of supply of any authorised distributors.

The Board of Trade, on the representation of the Commissioners, may authorise any district electricity board to abstract water from any river, stream, canal, inland navigation or other source, subject to such conditions as may be specified.

The powers and duties as to the generation and supply of electricity conferred on district electricity boards may be exercised and performed either by themselves or, if so authorised by the Commissioners, through any authorised undertakers or through a company established for the purpose. For the purposes aforesaid a district electricity board may lease their undertaking to any such undertakers or company.

If, within five years from the date of the vesting of any generating station or main transmission line in a district electricity board under this Act, any officer or servant who has been regularly employed in or about such station or line proves to the satisfaction of a referee appointed by the Minister of Labour that he has suffered loss of employment, or diminution of salary, or wages, otherwise than on grounds of misconduct, incapacity, or superannuation, and the district electricity board do not show to the satisfaction of the referee that equivalent employment on the like conditions as those obtaining with respect to him before the said date was available, the district electricity board shall pay him such compensation as the Minister of Labour shall think just, including any expenses which the officer or servant necessarily incurs in removing to another locality.

It shall be lawful for the Board of Trade after consultation with the Electricity Commissioners at any time before the establishment of a district electricity board for any area, and for two years after the establishment of any such board, to construct any works, and exercise any powers which a district electricity board can exercise under this Act.

The Treasury may issue to the Board of Trade out of the Consolidated Fund any sums not exceeding in the aggregate twenty million pounds, required for the construction of works or the acquisition of land, or required for providing working capital for such works, on such terms and conditions as to interest, repayment, and otherwise as the Treasury may think fit. The Treasury may borrow money for the purpose by means of the issue of Exchequer bonds.

At the expiration of two years after the establishment of a district electricity board, or earlier, any works and land acquired by the Board of Trade shall vest in that board, subject to the repayment to the Board of Trade of advances in respect of such works and lands.

During the period between the passing of this Act and the establishment of a district electricity board in any area, any authorised undertakers within the locality may, and if required by the Commissioners shall, enter into arrangements for mutual assistance in the supply of electricity, the management and working of the undertakings, the provision of capital required, &c.

The powers of the Local Government Board and the Secretary for Scotland and the London County Council with respect to the sanctioning of borrowing by local authorities will be transferred to the Electricity Commissioners.

Where the consent of the Board of Trade is obtained to the placing of any electric line above ground in any case, the consent of the local authority shall not be required, but the Board of Trade before giving consent shall give the local authority an opportunity of being heard.

A district electricity board or any authorised undertakers may place any electric line below ground across any land, and above ground across any land other than land laid out as building land or land so situate that the placing of lines above ground would affect the amenity of any dwelling house, in cases where the placing of such lines above ground is otherwise lawful.

Before placing any such line across any land the board or undertakers shall serve on the owner and occupier of the land notice of their intention; if, within twenty-one days, the owner and occupier fail to give their consent or attach to their consent stipulations to which the board or the undertakers object, the Board of Trade may, after giving all parties concerned an opportunity of being heard, give consent either unconditionally or subject to such terms as they think just.

A district electricity board and any local authority authorised by special Act or by order to supply electricity may provide, let for hire, and in respect thereof may connect, repair, maintain, and remove (but shall not manufacture or sell) electric lines, fittings, and appliances for all purposes for which electricity can be used.

The prices charged by a district electricity board for electricity shall be subject to the approval of the Electricity Commissioners, and shall be such that their receipts on income account will be sufficient to cover their expenditure on income account (including interest and sinking fund charges), with such margin as the Commissioners may allow.

The benefit of any reduction in the cost of electricity attributable to the provisions of this Act shall enure to consumers.

The Commissioners may require any authorised undertakers to alter the type of current, frequency, or pressure employed in their undertaking, and this shall be a purpose for which a local authority may borrow under the Electric Lighting Acts.

Anything which under the Electric Lighting Acts may be effected by a provisional order confirmed by Parliament may be effected by a special order made by the Electricity Commissioners and confirmed by the Board of Trade.

District electricity boards and authorised undertakers shall furnish to the Commissioners such accounts, statistics, and returns as they may require.

The accounts of every district electricity board and their officers shall be audited by auditors appointed by the Commissioners.

For any payment or work the cost of which ought to be spread over a term of years (including the payment of interest on money borrowed for capital expenditure whilst the expenditure remains unremunerative), and during the first three years after the establishment of the board for the purpose of providing working capital, a district electricity board may, with the consent of the Commissioners, borrow money. Where money is borrowed for the construction of works at a time when the cost of labour or materials is abnormally high, regard shall be had to that fact in fixing the period for repayment.

The Electricity Commissioners may, for the purpose of enabling a district electricity board to raise money, authorise the board to issue stock bearing interest. All such stock, and interest thereon, shall be charged on the undertaking and all the revenues of the district electricity board.

Any authorised undertakers within the district, and any consumer, or council, shall have power to give financial assistance in any form to the board, but in the case of a council not without the consent of the Local Government Board.

Money borrowed by a council for this purpose shall not be reckoned as part of the total debt of the council for the purpose of any limitation on borrowing.

The Electricity Commissioners may lend to a district electricity board or any authorised undertakers any money, not exceeding in the aggregate 25 million pounds, which the board or undertakers are authorised to borrow, if the Commissioners are satisfied that the board or undertakers cannot otherwise raise the money on reasonable terms.

Any such advances shall be issued out of a special fund to be under the charge of the Electricity Commissioners, and to be called the electricity loans fund, and to that fund shall be carried all sums received by the Commissioners on account of interest or of repayment of the loans made by them.

The Commissioners may issue stock, to be called electricity stock, bearing interest.

The Electricity Commissioners shall at the beginning of each financial year prepare an estimate of their receipts and expenditure during the year, and submit it for approval by the Board of Trade.

The Commissioners shall apportion the amount by which the estimated expenses exceed the estimated receipts amongst the several district electricity boards, in proportion to their gross receipts in the preceding year; and every such district board shall pay to them as a contribution towards their expenses the sum so apportioned: Provided that during the first five years after the passing of this Act the amount of such excess shall be paid out of moneys provided by Parliament, but such payments shall be treated as advances and shall be repaid, with interest at such rate as the Treasury may fix, by the Commissioners by equal annual instalments in the next three succeeding years.

Section four of the Conspiracy and Protection of Property Act, 1875 (which relates to breaches of contract by persons employed in the supply of gas or water), shall extend to persons employed by a district electricity board or by any authorised undertakers in like manner as it applies to persons mentioned in that section, with the substitution of references to electricity for the references to gas or water.

The Electricity Commissioners may hold such inquiries as they consider necessary or desirable for the purposes of this Act.

The Board of Trade and the Commissioners may respectively make rules in relation to applications and other proceedings before them under this Act.

A special order made under this Act by the Commissioners shall not have any effect unless and until confirmed by the Board of Trade. If objection is raised by any person, unless the order is amended, an inquiry shall be held.

Before any special order comes into force it shall be laid before each House of Parliament for a period not less than 30 days, and if either House presents an address to His Majesty against the order or any part thereof no further proceedings shall be taken thereon without prejudice to the making of any new order.

This Act shall apply to Scotland and Ireland, subject to necessary modifications.

In the event of a Ministry of Ways and Communications being established by an Act passed in the present session of Parliament, all the powers and duties of the Board of Trade under this Act, and under the Electric Lighting Acts, shall be transferred to the Minister of Ways and Communications.

The Bill is published by H.M. Stationery Office (Bill 72). Price 3d. net.

## CORRESPONDENCE.

***Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.***

### Waste.

Financial men tell us that this country is in debt, the currency is inflated, and to correct matters the native resources must be developed, inventions fostered, and all must work wisely and hard. It seems to me that this policy is the inverse of what is being followed in this country at the present time.

There is a statement in your issue of last week that the Canadian Government is going to spend $12,000,000 this year in further electric development of the water powers of Ontario. It is acknowledged here that coal resources should be conserved and water-power developed, but as yet there seems to be no practical policy in the matter. Railway electrification is coming, but the question of standardisation of system is still undecided. In the meantime, there are many good technical engineers in the country looking for work, or wasting time in trivialities—surely under a scientific Government these men would be used in investigating these problems and in standardising methods and systems.

Again, the much-debated question of the adoption of the metric system is still undecided while the country is entering the race for commercial supremacy. In a question of armaments, a matter of £2,000,000 for a battleship is nothing. Possibly the Government will wake up one day to the fact that its aforetime unnoticed technical ability has emigrated to those countries where it is appreciated.

**Reader.**

*May 6th*, 1919.

### The E.P.E.A. Award.

I feel sure that there must be many chief engineers of small undertakings like my own who have from time to time received niggardly advances, not as war bonuses, quite inadequate to the now high cost of living, and yet have refrained from joining a trade or professional union such as the above, on the ground that it would be *infra dig*. Well, Mr. Editor, with your inner-circle knowledge, can you or any of our friends tell us whether this is a *bona-fide* award that is backed by the Government, or is it, in the words of the crowd, a "wash-out"? Do some of the big stations participate and the small ones not? In case it is a Government award, what steps does the Association take, or the Government, to enforce it? If it is not a Government award, would it not be better for the E.P.E.A. to amalgamate with the E.T.U. and thereby share the proportionate advances in wages that have been granted to that Union?

I can heartily endorse the remarks of Mr. Connaught Smith and "Nil Desperandum." The E.P.E.A. seems to me to take the attitude of the old "passive resisters," who gradually died out of existence.

**H. A. Harding.**

Bognor Electricity Works, Sussex, *May 6th*, 1919.

### The Re-settlement of Officers.

For several weeks quite a number of letters were printed in the ELECTRICAL REVIEW on the question of "preference for officers" by "Fed-Up," "Sapper," &c. The notice which is now displayed in Post Offices distinctly states "for officers and men of like standing in civil life." However, that is not what I wish to discuss. Two months ago I made application under the scheme for training in electrical engineering and maintenance towards the same. I wrote the District Director of the Appointments Department asking the reason for the delay, and, after waiting all this time, his reply states that the application is awaiting consideration by the Interviewing Board.

Now, as I served in the ranks, I was unfortunate not to get a commission. Am I having to take a back seat while officers get preference, or are officers kept waiting similarly for fresh supplies of red tape? It is three months since I was demobilised, and so far I haven't drawn a penny, and I am too proud to draw the O.W.D. of 29s. per week. How am I expected to live?

Again, are employers acting squarely towards those who have returned to civil life, officers or men? I have written to several large electrical undertakings stating my qualifications, and asking if they would give me the chance I was desiring, but I invariably received the same answer. Admitted that I want some training, but how am I to get it under such circumstances?

I suggest that employers soften their hearts towards the demobilised soldier, and give him all the help they can, and as the Excess Profits Tax has been decreased by one-half they could, at any rate, afford to use that half on training one or two who, in their opinion, would make good business men. Give them the chance for a few months; then if they have made no progress, there is only one alternative. Offer them a living wage. By that I don't mean money for nothing, as our friends the Labour Party are asking, but I believe the labourer is worthy of his hire. Would a director of a firm of electrical engineers employing several hundred hands state his views, please?

**Still Trying.**

*May 6th*, 1919.

[We refer to this subject in our leading columns to-day.—EDS. ELEC. REV.]

### Telephone and Telegraph Line Construction.

With reference to your correspondent Mr. Barlow, *re* the above, in answer to my letter in a previous issue of the ELECTRICAL REVIEW, I wish to say that Mr. Barlow is undoubtedly correct as regards the cost, and present charges to the public for usage of the wires. It is *expensive* laying telegraph and telephone wires underground.

The reason of my astonishment, however, was more, perhaps, political, seeing that the authorities *were* laying or *had* laid miles of telegraph and telephone wires inland underground. I have heard some people remark: "If you want secrecy it would be just as easy to 'tap' a buried wire as an overhead wire." This is *not* the case. The underground wires would be, in special cases, located by means of a *pocket compass* and sign posts with a *cipher or code direction* on one side of it, and on the other side the penalty for wilful removal of such direction post. The authorities or owners of the buried wires would be in possession of the "key" cipher book, faults, of course, being tested for in the usual way, as for submarine cables.

I hope in time all telegraph and telephone wires will be laid underground, and it may perhaps facilitate or reduce costs when the new electric power schemes now coming forward are brought about. The telegraph wires could be laid at the same time; not necessarily in the same trough or very near the power cables trough.

**D. R. Broadbent.**

London, S.W.1, *May 9th*, 1919.

### The Election of the I.E.E. Council.

Now that another election has taken place, it would be interesting to know how many of the 5,000 corporate members who are entitled to vote have exercised their right. From my own observation, about nine out of every ten dropped their voting papers into the waste-paper basket, and the reason for this indifference is not far to seek.

There are approximately 1,500 full members who have the right, if groups of ten are agreed, to nominate candidates for the Council. The Council, therefore, always nominates a few more men than there are vacancies, to give the members a choice, knowing that if it gave no choice, the members would take the matter into their own hands, and nominate an opposition. This year, the Council nominated seven members for three vacancies.

When it comes to associate member representatives, however, the Council gives them no choice at all, merely nominating three men for three vacancies, knowing that the 3,500 associate members must accept its choice, as they are barred from nominating any opposition. It is not surprising, therefore, to find that the average associate member takes no interest in the election, and that there is a general impression among them that the Council of the I.E.E. does not put itself out to study their interests at all, and it is only when it wants to get their votes, as when the subscriptions were raised, that any redress can be obtained from the Council to long-outstanding grievances.

In the past, the Council could safely ignore the opinions of the general members, for there was no cohesion among them, and they could not, therefore, take united action; but times are changing now, and electrical men especially are forming associations of their own which contain a high proportion of I.E.E. members. If action against the Council were taken by any of these groups the apathy of the average member when a ballot is being taken is likely to react very seriously against the Council, for it would not take many hundred members voting together to defeat the Council at every election, but the Council seems to be blind to the signs of the times.

It is stated on good authority that four candidates, two of them associate members, with very strong backing, were

nominated for the last election, but were disqualified owing to a technical error, which could have been rectified in a few hours, but they were not notified till too late, although there was sufficient time between the receipt of the nominations and the closing date. The Easter holidays may have had something to do with the delay, but the Council has committed too many tactical blunders in the past to make its victims willing to give it the benefit of the doubt.

The Council could do a great deal to arouse interest in the Institution by treating the associate members as fairly as it treats the members, by giving them a choice of representatives at elections. It could do this either by having extra Council nominees for each grade, or by giving the other corporate members the same right to nominate candidates as the present full members. I am afraid the remedy is too obvious for the Council of the I.E.E.

**An Associate Member.**

*May 11th*, 1919.

[We refer to this matter in our leading columns.—Eds. Elec. Rev.]

### The Field of the Electrical Contractor.

The excellent article in your issue of May 2nd, by Mr. Donald Smeaton Munro, under the above title, of course touches only the fringe of what I venture to call the scandal to which he refers.

One of the points which it does not cover is the responsibility of the contractor for a very large portion of his wrongs, inasmuch as he, unlike the members of "nearly all other respectable trades," is perfectly content to place his orders with the Manu Factor-Contractor who is his bitterest opponent, instead of supporting the firms, and there are such, who confine themselves to the supply branch of the business as distinct from those who try "running with the hare and hunting with the hounds."

For years I fought the battle of the contractor at the council table of the British Electrical Manufacturers' Association (out of which the "B.E.A.M.A." sprang), of which I was one of the founders; *inter alia* doing my best, also, to wrest the control of the Association from the hands of the alien element who largely preponderated in it, and make it really British. Again and again I objected, sometimes successfully, to the election of firms who notoriously posed as contractors, whilst, in one case at least, also calling themselves consulting engineers, manufacturers, factors, and agents—all the lot—and resigned from the sub-committee which met the Electrical Contractors' Association, respecting a special preferential allowance of 2½ per cent., which it was suggested should be given them by the manufacturers, because a highly respected contractor then and there convicted a member of the sub-committee of being, *sub rosa*, a contractor.

But I fear my time and energy were entirely thrown away, for, although this incident occurred many years ago, the firm in question, who have not, I believe, yet mended their ways, are still largely supported by what I regard as the suicidal policy of contractors in placing orders with them and similar establishments.

If, as Mr. Munro justly says, "The electrical contractors . . . are the infantry of the line . . . there is little wisdom in turning all the heavy ordnance, tanks, and aeroplanes of the electrical army into instruments for the decimation of their own infantry," what can be said of the "infantry" who traitorously assist in doing so?

Further, the insane cry of the user for cheapness, and the equally mad competition between contractors to give it, has led to the gradual introduction of apparatus which will just, and only just, pass the tests and fulfil its desired duties, shading off into the absolute dishonesty of altering a maker's capacity plate, attached to an electric motor, for instance, to do as much as double its guaranteed H.P. (and overloading it at that), with the result that the outraged maker has been forced, for his own reputation's sake, to take a hand in the deal.

That electrical contracting would ultimately be taken up by plumbers, ironmongers, &c., was long foreseen by the pioneers of the industry, and this will continue, and grow in frequency, until it is recognised as a skilled, a technical, calling, and steps are taken, by the contractors themselves, to render it impossible for any wireman's mate, who chooses to do so, calling himself "electrical engineer and contractor."

Not that I wish to "throw bricks" at every plumber or ironmonger who does so, or tar them all with the same brush; I know many, and am glad to number them amongst my supporters, who employ good electrical men to run that branch of their business, or call in competent firms to act as sub-contractors, their methods being to my mind quite legitimate.

"In nearly all other respectable trades" business is strictly divided into three divisions—manufacturers, factors (or wholesalers), and retailers—none of which attempts to bridge the others.

But if, in the electrical trade, the contractor or retailer is hard hit, so also is the factor who has to contend with the same prices being quoted to the retailer as he can himself get from many of the manufacturers.

However, this, as Kipling says, "is another story," with which, unless you are interested in it on some future occasion, I do not propose to take up your space, although I think I could show that the attempt to suppress the factor is as greatly to the contractor's detriment as for the manufacturer to get at his customers direct.

I have a great objection to anonymity, but I have a greater, and you doubtless have also, to any attempt to obtain a free advertisement out of the technical Press, so consider myself justified in signing this,

**One of the Pioneers.**

*May 12th*, 1919.

## LEGAL.

### Fraser & Chalmers, Ltd.

Mr. Justice Astbury had before him in the Chancery Division, last week, a question raised by the liquidator of this company, concerning the principle that should be adopted to determine the manner of distributing the surplus assets (£150,000) that remain after payment of all liabilities. His Lordship decided that the surplus assets should be rateably distributed between the ordinary and preference shareholders.

### Compensation Claim.

At Bradford County Court, last Friday, Mrs. Jane Kershaw, widow of Mr. Henry Kershaw, who was killed by electric shock last June at the works of Thwaites Bros., Ltd., engineers, Bradford, and three illegitimate children of Kershaw by another woman, claimed £300 compensation. Kershaw was a power-house attendant. In seeing that things were right before leaving on a Sunday evening, he, apparently, noticed something wrong with a switch. Whilst he had his head and shoulders in a high tension cubicle there was a flash, all the lights went out, and half the cubicle seemed to be in flames. Kershaw was dead. It was contended that even if the man did a foolish act it was clearly within the scope of his employment. If he had succeeded he would probably have been "patted on the back."

Mr. F. G. Smith (for defendants): I don't know about that. If the poor man had lived he would have been instantly dismissed.

Mr. Andrew Ryan, the engineer, said Kershaw had no right to adjust anything. He should have reported anything wrong to him (witness).

His Honour Judge Macklin said if anybody in authority had told Kershaw to do what he did, he would have been liable to a charge of manslaughter. As it was, the man took upon himself to go right outside his employment. He therefore gave judgment for defendants, but in commenting on the generosity of the firm towards the children and their mother, he hoped they would extend it to the widow.

### Meharey *v.* Belfast Corporation.

The resident magistrate for Belfast delivered his considered judgment in this test case (see Elec. Rev., May 9th, p. 534) on Monday. In giving judgment for the defendants, the magistrate said the facts were admitted, and the question was one of law. The defendants only received two days' notice of the strike, and he held that it was impossible for them in that time to procure the necessary labour to carry on the work.

### Prigot *v.* Electric & Ordnance Accessories Co., Ltd.

At the Birmingham County Court on the 7th inst., a Belgian mechanic named Prigot sued the defendants for damages for wrongful dismissal. He commenced to work for the company on October 15th, and after three months the contract was revised, plaintiff's engagement being fixed for the duration of the war. In December, 1918, he was told that he would be suspended. Counsel argued that as the war had not yet come to an end plaintiff was entitled to damages for wrongful dismissal. For the defendants, it was stated that the plaintiff, upon his dismissal, accepted a week's wages in lieu of notice, and said he was satisfied with the arrangement. This, said counsel, amounted to a mutual discharge of the contract whatever it was.

Judge Amphlett, in giving judgment for the plaintiff, awarding £75 damages, said that the contract was not terminated by plaintiff's acceptance of a week's wages.

### Defective Tramway Track: Compensation Case.

In the Southwark County Court on Monday, £30 damages was awarded a woman omnibus conductor for personal injuries due to a collision between her omnibus and a van belonging to Hay's Wharf, Ltd., who attributed the accident to defective L.C.C. tramway lines. According to the *Times* report the Judge said that the London County Council was responsible for the proper care of the tramway lines of London, and it was its duty to prevent the possibility of accidents caused by defective rails, notwithstanding the scarcity of labour or of material. He decided that the London County Council was responsible for the accident to the plaintiff, and he awarded her the amount mentioned, and made an order that the Council must pay the costs of Hay's Wharf.

# BUSINESS NOTES.

**Letters from the Forces.**—A Captain in the R.A.F. writes from France thanking us for the ELECTRICAL REVIEW, which had been sent to him for some considerable time; he adds:—"It is pleasant to see such an old friend come out of war times stronger than ever, both in circulation and, I think, technical and literary interest."

**Stocks of Non-Ferrous Materials.**—The following particulars are published of the stocks (exclusive of old metal and scrap) in this country in possession of the Minister of Munitions on May 1st, 1919:—

| | |
|---|---|
| Copper | 51,190 tons |
| Spelter, g.o.b. | 26,912 " |
| Spelter, refined | 7,057 " |
| Aluminium | 11,542 " |
| Soft pig lead | 109,012 " |
| Nickel | 2,567 " |
| Antimony regulus | 4,461 " |

**Import Restrictions Removed.**—The President of the Board of Trade, after duly considering the recommendations of the Consultative Council on Imports, has given the following further directions in regard to the Prohibitions of Import:—

The restrictions on the importation of the following goods are to be removed:—

81. Malleable tube fittings.
82. Pressure regulators, lubricators, grease cups, injectors and ejectors, pump and engine governors, pressure and vacuum gauges.
83. Expansion joints, iron or brass.
84. Pressed steel union couplings.
85. Water-gauge fittings.
86. Steam traps.
87. Metallic steam packing.
88. Brass wire, copper wire, copper-clad wire, phosphor wire, coppered steel spring wire, tinned mattress wire, wire, leading-in nickelled copper, steel wire coppered and flattened.
89. Wire rope sockets, drop forged steel.
90. Copper rods and steel and iron wire rods.
91. Antimony, crude, regulus, and sulphide.
96. Mathematical instruments and screws for same.
97. Oil cans.
105. Waste or scrap rubber.

General licences have been issued for the above articles.

The importation of the following articles is to be licensed only exceptionally, as and when required:—

119. Brass rods, tape, and strip; brass-coated tubes, brass or copper tubes, and brass hose clamps.
120. Nickel wire.
122. Iron and steel valves, cocks for gas, water and steam and iron foot valves.
127. Semi-rotary pumps.
128. Steel and iron wire, wire bale ties, and galvanised wire.
133. The following kinds of glass and glassware:—
Scientific.
Machinery.
Optical.
Miners' lamp glasses and miners' electric lamps.

The importation of the following articles is to be restricted as shown:—

141. Importation of gun metal, brass or bronze valves for gas, water, and steam is to be restricted to 100 per cent. of 1916 imports.
143. Glassware (including bottles and jars), other than scientific glass and glassware, machinery glass and glassware, optical glass and manufactures thereof, miners' lamp glasses and miners' electric lamps, are to be admitted at the rate of 50 per cent. of 1918 imports.

Applications for special licences should be made, as usual, to the Department of Import Restrictions, 22, Carlisle Place, London, S.W. 1.

A list of articles indicating what is included under the heading of scientific glassware is printed in this week's issue of the *Board of Trade Journal*.

**Housing by Public Utility Societies.**—The Local Government Board has issued a small penny booklet with this title showing in simple terms how small groups of people, whether of workers, or of workers acting jointly with employers, or of other individuals, may band themselves together for the purpose of promoting housing schemes and obtaining financial assistance from the State. It is felt that with the facilities which the Government proposes to give, groups of people associated together in these societies may do much to supplement the work of local authorities and to help towards a solution of the housing shortage.

**Exhibitions of 1920.**—The British Industries Fair of March next will be held at the Crystal Palace. In the following summer the buildings will be used for an Imperial War Exhibition.

**"What Licked the Kaiser?"**—This is the title of a booklet issued by the aggressive Society of Electrical Development (U.S.A.). It leads off by showing that it was by means of "co-operation" that the "most efficient hell-raising organisation the world has ever seen" was smashed, and it is by "co-operation" that the bill will be paid. The Society is the means for promoting electrical co-operation; the pamphlet tells us what it has done and hopes to do in that direction. We are seriously assured that the pamphlet was not meant to be facetious.

**Reconstruction Problems.**—No. 23 of the series of Grey pamphlets issued by the Ministry of Reconstruction is Part 2 of the consideration of Public Health questions, and it deals with "The Present Problem and the Ministry of Health."

**Patent Restoration.**—Mr. W. R. Pilkington has applied for the restoration of Patent No. 2,343 of 1914, for "Improvements in air or other fluid-pressure pumps." Mr. W. B. Good & Rebesi, Ltd., have applied for restoration of Patent No. 6,887 of 1913, for "An Automatic Morse Recorder."

**Demobilised Men Entertained.**—About 130 employés of the Birmingham electric supply undertaking who have been serving with H.M. Forces, and have already been demobilised, were entertained by their colleagues at a dinner and concert, last week. Owing to the large number of guests and visitors, the dinner was served in two dining halls, presided over by Mr. R. A. Chattock, city electrical engineer, and Mr. E. J. Jennings, secretary, respectively. During the evening a cordial "welcome home" was extended to the men by the Lord Mayor and Mr. Councillor Burman (the chairman of the Committee). Presentations were made to Messrs. Whiting and Kirby, honorary secretaries to the War Funds and War Relief Organisation of the department.

**Foreign Trade.—THE APRIL FIGURES.**—The official returns of imports and exports during last month contain the following electrical and machinery figures:—

| IMPORTS. | *April*, 1919. | *Inc. or dec.* | *4 months*, 1919. *Inc. or dec.* |
|---|---|---|---|
| | £ | £ | £ |
| Electrical goods, &c. ... | 132,664 | + 68,019 | + 147,845 |
| Machinery ... ... | 1,094,368 | + 340,211 | + 2,000,943 |
| EXPORTS. | | | |
| Electrical goods, &c. ... | 366,998 | + 221,754 | + 683,161 |
| Machinery ... ... | 2,010,858 | + 702,762 | + 2,217,654 |

**International Competition in Aluminium.**—The chairman of the Aluminium Industrie A.G., of Neuhausen, addressing the shareholders at the recent general meeting, is reported to have stated that the rumours were absolutely without foundation which had been circulated that the company's gross profits in 1918 were higher by £800,000 than was shown in the accounts for the year. Discussing the future prospects of the undertaking, he expressed the opinion that extremely severe competition was to be expected, as rivals in other countries had become considerably strengthened during the course of the war. The strength of the Neuhausen company lay in the fact that the installations had been written down very considerably, and the business policy must continue in the direction of keeping the value of the installations at such a low level that the cost of production was only affected to a slight extent by the financial charges for interest and redemption, particularly in regard to the hydro-electric works, so as to keep the cost of electrical energy as low as possible. Moreover, it was essential to develop the works and provide for a uniform utilisation of the water powers, which varied according to the time of the year, and it was also unconditionally necessary to take into account in the policy of profit distribution the totally changed political and economic conditions, and the resulting uncertainty as to the future. The chairman further stated that the principal customer was the Krupp Co.; the installations in Hungary had been socialised, but nothing was known as to the situation in Roumania.

**Dispute at Rochdale.**—A correspondent states that trouble has arisen at a Rochdale mill through the dismissal of two employés who are members of the Electrical Trades Union, and the members of that and other unions consider they should be reinstated. An ultimatum is to be presented to the employers to cease work if an amicable settlement is not reached.

**Safeguards in the Workshop.**—The British Fire Prevention Committee have decided to issue, in the form of a "folder," some useful reminders to the factory owner, manager and foreman, as to the prevention of fire. The present season has been selected for the issue, as so many works are reorganising their establishments for post-war activities. Folder No. 1, entitled "Safeguards in the Workshop," contains valuable and timely hints which should be laid to heart by those concerned. Copies are provided gratuitously to applicants who address the Registrar of the Committee in writing at 8, Waterloo Place, Pall Mall, S.W. 1, with an addressed and stamped envelope enclosed.

**Catalogues Wanted.**—The Imperial Trade Correspondent at Victoria, B.C., Mr. J. J. Shallcross, P.O. Drawer 730, Victoria, B.C., is getting together a complete library of catalogues and trade literature for reference by local importers. British catalogues of machinery, hardware and glassware, electrical appliances, especially including those for unit lighting systems for farmhouses and other buildings, are wanted.

The British Vice-Consul at Granada is asking for British catalogues in Spanish for distribution among Spanish firms in his district.

**Birmingham Commercial Library Opened.**—The Lord Mayor (Sir David Brooks) recently opened the new commercial and technical library which has been established by the Corporation in the new Council House Buildings. The library will provide all Consular and trade reports, manufacturers' catalogues, &c., and technical and industrial books. The assistants will help inquirers to obtain information, and as far as practicable questions will be answered on the telephone. The Lord Mayor stated that while the general reader should be provided for, adequate facilities should be made for the student, the research worker, the scientific man, and the man of commerce. Mr. H. C. Field, President of the Birmingham Chamber of Commerce (who is an export merchant), insisted that the fault for insufficient commercial development and knowledge lay largely with the English commercial classes themselves. We had been too apt to devote our attention to our offices and factories without taking a sufficiently wide outlook on commerce as a whole, on possibilities of development, and on our relations with different countries.

**The Belgian Charleroi Works.**—The report of the directors of the Ateliers de Constructions Electriques, of Charleroi, which was approved at the general meeting held towards the end of last month, stated that the company would be able at once to resume peace manufactures, excepting in the case of cables, with a reduced rate of production. The rate, however, would rapidly increase with the arrival of new machinery and the return of recovered machinery, which would not occupy very long. It was possible to foresee the return shortly of a large portion of the cable factory machinery, and it was hoped that the works would have regained the full productive capacity before the end of the present year. A number of new machines purchased in America, and the delivery of which had begun, would permit of a material expansion of the output. The company were preparing to meet the extension of markets which was in prospect. The new conditions of labour would compel industries to electrify their equipment in order to reduce the cost of labour, and the Belgian Government had under consideration the question of the conversion of some railways to electric traction. The development of the uses of electricity would be hastened on all hands, and the demand for electrical plant had become more considerable. The balance sheet at the end of 1918, resulting from the management of the German sequestration, showed a provisional deficit of £93,000, but the directors adopted an attitude of reserve as to the accuracy of the accounts, which would only become definite when the compensation for war damages had been ascertained.

**Japanese Competition.**—Writing in *Unity*, (May issue) Mr. Stanley de Brath, M.Inst.C.E., says: "National prosperity depends on national trade, and the vast burdens which the war has left behind can be carried only by an unprecedented volume of production and cheap transport. Already Japanese and American trade has gone up by leaps and bounds at our expense. The case of Japan is interesting. The suicidal quarrels of the white races have been pure good luck to the yellow race. Before the war Japan had overborrowed to an extent which made her solvency dependent on a continuance of good rice seasons. Now, thanks to the flood of gold which has poured over to the Far East, her credit stands higher than ever. One thing is certain—if we in Europe raise the price of living by low production, Japan and China will certainly lower it by cheap labour and transport; and the lowering will be at our expense by supplanting us in neutral markets. It needs no prophet to foretell that the exhaustion of Europe will be the opportunity of Asia; many Asiatics are thinking so. Scientific management is familiar to Japan; it will surely arise in China, whose vast coal and iron fields, *closed to Europeans* by the agreement between China and Japan, are being exploited by the cheapest and most contented labour in the world. It is rapidly becoming so in India, whose teeming population is almost as simple in its mode of life as the Chinese coolie. There is no 'labour unrest' in the East."

**Exports to Europe.**—The Overseas Trade Department states that the present position in regard to the control over exports to Norway, Sweden, Denmark, Holland, and Switzerland is as follows:—

1. Goods on sections A, B, and D of the list of prohibited exports can only be exported provided a licence is first obtained from the Export Licence Department, 4, Central Buildings, Westminster, S.W.1.

2. Goods on the list of "free" exports may be exported without any formality whatever.

3. Goods on section C of prohibited exports (other than such goods as appear on section D) may be shipped (not posted) without licence provided the following conditions are observed:—

(*a*) NORWAY AND SWEDEN.—Individual guarantees in respect of exports are no longer required provided the goods are consigned to the appropriate Import Association on account of the actual consignee. Should the consignee declare that the Import Association will not accept consignment, the goods should be consigned to the Inter-Allied Trade Committee at Christiania or Stockholm, as the case may be, on account of the actual consignee. This method of consignment must also be adopted in the case of goods which are not consignable to any import association. In order that the method of consignment may be checked, an arrangement has been made whereby shippers are to forward the Customs Shipping Bills or specifications (whichever are required under Customs regulations) to the Export Licence Department, 4, Central Buildings, Westminster, S.W.1 (in envelopes marked "Shipping Section") for approval. Should the exporter actually have received a guarantee against re-export in respect of the transaction, it should be forwarded with the shipping bill or specification, and if the guarantee has previously been sent to the Export Licence Department the reference number of the relative papers should be furnished. The shipping bills, or specifications will be amended if necessary and returned to the shippers stamped "approved." Upon the production of approved shipping bills or specifications, shipment will be allowed by H.M. Customs without any form of guarantee, subject to the usual Customs formalities. This procedure will not apply to any licences which have already been issued or which may hereafter be issued in special cases.

Should exporters prefer, they may forward to the Export Licence Department a duplicate of the usual advice sent to their shipping agents in lieu of a shipping bill or specification. The advice will then be stamped and returned to them (or to their shipping agents if requested) for production to the Customs with the usual shipping bill or specification. Documents addressed to the Shipping Branch of the Export Licence Department will be dealt with at once and dispatched to exporters by return post.

(*b*) DENMARK.—The goods should be consigned direct to the consignee provided certificate from the Danish Chamber of Manufacturers or Danish Merchant Guild is produced to His Majesty's Customs at the time of shipment. Should the consignee declare that the Chamber or Guild refuse to issue the necessary certificate,* shipment will be allowed without certificate, if the goods are consigned to the Inter-Allied Trade Committee at Copenhagen on account of the actual consignee.

(*c*) HOLLAND.—N.O.T. certificates are no longer required, but goods must be consigned to the Netherlands Overseas Trust on account of the actual consignee. Should the consignee declare that the N.O.T. will not accept consignment,* shipment will be allowed provided the goods are consigned to the Inter-Allied Trade Committee at The Hague on account of the actual consignee.†

(*d*) SWITZERLAND.—S.S.S. certificates are no longer required, but goods must be consigned to the Société Suisse de Surveillance Economique on account of the actual consignee. Should the consignee declare that the S.S.S. will not accept consignment*, shipment will be allowed if the goods are consigned to the British Legation at Berne on account of the actual consignee.†

4. For consignments (*a*) for the personal use of the consignee, (*b*) for trade purposes of not more than £5 in value, or (*c*) to be exported by parcel post, it is proposed to continue to issue export licences in order to obviate consignment difficulties. These licences will be issued with the utmost expedition.

5. Where licences are already held by exporters in respect of goods which under the above regulations may now be exported without licence, the following points should be noted:—

NORWAY AND SWEDEN.—Shipment will be permitted under the licences without the production of approved shipping bills—*Vide* 3 (*a*).

DENMARK.—Shipment will be permitted under the licences without the production of guarantees—*Vide* 3 (*b*).

HOLLAND AND SWITZERLAND.—Shipment will be permitted under the licences without the production of N.O.T. or S.S.S. certificates, even though the production of such certificates to H.M. Customs may be stipulated in the licences —*Vide* 3 (*c*) and (*d*).

6. N.O.T. and S.S.S. certificates which under the new regulations are not now required should be handed to H.M. Customs for disposal at the time of shipment.

* It is suggested that before any consignments are dispatched, exporters should ascertain by reference to the consignee whether the Import Association will accept consignment.

† The Inter-Allied Trade Committee or the British Legation at Berne, as the case may be, will endorse the bills of lading (without any financial liability) on receipt of satisfactory guarantees from the importer.

**The Banks of the Rhine.**—The Board of Trade have extended their General Licence authorising, on certain conditions, the supply of goods to the territories on the left bank of the Rhine in the occupation of the Armies of the Associated Governments, so as to cover, on the same conditions, the supply of goods to the occupied districts on the right bank. As regards both banks of the Rhine, applications should be made to the Export Licence Department, 4, Central Buildings, Westminster, S.W.1, in respect of goods remaining on Sections "A" or "B" of the Prohibited List which it is desired to dispatch to the occupied areas (including Luxembourg). Goods on Section "C" of the Prohibited List do not now require a licence for export to the above-mentioned territory, provided, in the case of shipment *vid* Holland, they are first consigned to the Standard Bank of South Africa, Rotterdam. Goods on the "free" list may continue to be exported free of all restrictions. No import permit from the authorities in the occupied areas is now necessary.

**Export Prohibitions.**—The *London Gazette* for May 9th contains a further list of alterations in export prohibitions.

**Catalogues and Lists.**—MESSRS. GEORGE KENT, LTD., 199-201, High Holborn, London, W.C.—Twenty-four-page fully illustrated catalogue (Section 8) of steam meters. The contents include a general description of the apparatus; the two forms of orifice fittings (fixed and variable) are shown by means of excellent diagrams. Other information relates to the rate of flow indicator; the diagram steam flow recorder; the planimeter, which is described, and the counter and diagram steam flow recorders. A loose sheet of prices and shipping weights is given.

THE HERBERT FRODD CO., LTD., Sovereign Mills, Chapel-en-le-Frith.—An eight-sheet "Personal Message" explains the firm's business in the production of "Ferodo" friction linings for clutch, brake, and other duty. The illustrations include one showing the research laboratory and testing department.

"EASY-FIX" FITTINGS CO., 66, Victoria Street, London, S.W. 1.—Advance illustrated descriptive leaflet of the "Easy-Fix" conduit fittings.

MESSRS. J. & E. DALTON & CO., LTD., Albion Emery Works, New Mills, near Stockport.—Circular describing their solid woven endless polishing bands, for use on Linisher or other polishing machines.

THE MIRRLEES-WATSON CO., LTD., Scotland Street, Glasgow.—Illustrated descriptive circular No. C 1,000, relating to the Mirrlees tube cleaning apparatus for surface condensers.

MESSRS. HIGGS BROS., Sand Pits, Birmingham.—Stock lists of shunt-wound interpole motors, 110 volts, 230 volts and 460 volts.

MESSRS. GRIFFITHS BROS. & CO., LONDON, LTD.—Specimens of "Shaydolite" for colouring or frosting electric large bulbs by immersion.

**Book Notices.**—Bureau of Standards. Radio Pamphlet No. 40. "The Principles Underlying Radio-Communication." Washington: Government Printing Office. Price 55 cents.

"Modern Electrical Engineering." In six volumes. Edited by Prof. Magnus Maclean. London: Gresham Publishing Co. Price 12s. 6d. each net.

The eighth number of the *Journal* of the British Science Guild, containing a report on Industrial Research and the Supply of Trained Scientific Workers, particulars of the British Scientific Products Exhibition, 1918, &c., may be obtained on application to the Secretary, British Science Guild, 199, Piccadilly, W. 1, price 6d. per copy.

**New French Company.**—A new company has lately been formed in Paris with a capital of £5,600, and the title La Société Chauffage Electrique Domestique et Industriel (C.E.D.I.), to manufacture electric heating and cooking apparatus.

**Trade Announcements.**—Mr. L. G. Hawkins has severed his connection with the Hotpoint Electric Heating Co., and established an electric appliance business as L. G. Hawkins & Co., at 116, Charing Cross Road, London, W.C. 2. The firm will control the business in the "Universal" electrical appliances in the British Isles and on the Continent. They have been appointed European representatives for the Geyser Electric Co. (laundry machines); the Ramey Manufacturing Co. (Inc.) "Simplex" and "New Pacific" vacuum cleaners; the Empire Transformer Co. (Inc.) Bell transformers. The Oriental Tube Co., Ltd., of West Bromwich, have appointed the firm to be their sole representatives for electric conduits, &c., in the British Isles. Mr. L. G. Hawkins and Mr. E. P. Bennett will shortly be visiting Continental countries, as they announce in our advertising pages to-day, and are open to undertake business negotiations.

With reference to the negotiations that were in progress for amalgamating the interests of four battery firms, it is announced in our advertising pages that as no agreement has been arrived at the negotiations have been broken off, and the respective companies will continue to carry on their businesses independently.

Mr. W. P. Durtnall informs us that though the works at Jeumont, in France, were thoroughly smashed up by the Germans, in about six months the "Paragon" machinery, for which Capt. Lucien Failon is representative, will be available for France and the French Colonies. Arrangements had been completed just before the war for this purpose, and similar plans are pending for the United States, in connection with Mr. Durtnall's inventions for marine propulsion and railway traction.

Messrs. Ferguson & M'Lauchlane have commenced business as electrical engineers, at 94, Drygate Street, Larkhall, Hamilton.

Messrs. Dorman & Smith, Ltd., of Manchester, have appointed Messrs. Andrews & Co., 40, West Campbell Street, Glasgow, as their representatives for Scotland.

Customers of the "Z" Electric Lamp Manufacturing Co., Ltd., are asked to take note that the Bristol telephone number of the company has recently been altered to "Bristol 4273."

The Hart Accumulator Co., Ltd., has removed its Manchester branch office to larger premises at 4, Victoria Bridge, Manchester.

Mr. Geo. H. Rattle, electrician, having been released from Government inspection work with the Air Force, has reopened business at Station Road, Oxted, Surrey.

Messrs. Webb & Co., of Birmingham, have taken premises at Stourport, for the establishment of electrical engineering works.

Messrs. Speedy & Eynon have removed to 22, Essex Street, Strand, London, W.C. 2. Their telephone number is unchanged.

Mr. R. A. Giffen, electrical engineer and contractor, of Chequer Street, St. Albans, has (owing to expansion of business) taken into partnership Mr. L. G. Hosier, of the same city. The business will be carried on as heretofore at the same address, under the style of Giffen & Hosier.

**Agencies in Russia.**—H.M. Consul-General at Gothenburg reports that a firm of agents in that city desire to obtain agencies in Russia for United Kingdom manufacturers and exporters of electrical supplies and materials, central heating fittings, steel pens, &c. (Reference No. 877.)—*Board of Trade Journal.*

**Wages of Women Cable Makers.**—The *Times* states that women and girls employed in the cable-making trade, including the electrical section, are under an award of a court of arbitration to receive an advance in wages of 5s. and 2s. 6d. respectively, provided the total advances over pre-war rates shall not exceed 20s. and 10s.

**Australian Copper Mines Close Down.**—The *Times* learns that private advices have been received to the effect that all the copper mines and smelters of Australia, except the Mount Morgan and Mount Lyell, have been closed down as the result of the enormous stocks of metal which are held and the comparatively small consumption of the metal since the Armistice was signed. Certain proposals were made to the British Government on behalf of the producers with a view to enabling the mines to continue working, but they having been rejected the mines have suspended operations.

The *Melbourne Age* for March 14th contains an article in which it is stated that the huge accumulated war stocks of metals abroad were making the immediate sale of Australian metals a difficult matter. The Acting Prime Minister, in the course of a statement on the position, said that there was a restriction on the export of base minerals and ores, the chief reason being found in the policy of the Commonwealth Government, which was to have all minerals and ores, as far as possible, refined within the Commonwealth. There could be no two opinions regarding the soundness of this policy. Encouraged by the Government, vast development had occurred during the war, and several branches of the industry had been preserved and stabilised. Copper works had been extended and new plants installed, the capacity of which was ample to smelt and refine all copper material produced in the Commonwealth. The largest silver-lead smelting works and refinery in the world was now possessed by Australia at Port Pirie, the output being 150,000 tons of pig-lead per annum, and 5,000,000 to 6,000,000 oz. of silver. The electrolytic zinc works in Tasmania were being extended, and when complete the capital involved in the scheme would approximate £2,000,000.

Mr. Watt stated that the restrictions necessarily imposed on the export of raw copper had nothing whatever to do with the existing difficulties. If the embargo were lifted, no relief would be given in present circumstances. Until the stocks of copper and other non-ferrous metals that had accumulated during the war had been absorbed in peaceful arts and manufactures, there was no possibility of finding profitable markets. Stocks of copper material held by the British Government in various parts of the world represented in value £30,000,000, and the United States Government had also vast accumulations. America had been unloading its copper on the market for some little time, and these forced sales were the cause of the depression in price and difficulty of disposal. There were many thousands of pounds' worth of mined copper in Australia. The Imperial Government had a stock of refined copper there of approximately 20,000 tons, which had cost it about £120 a ton, including interest and other charges, and instructions were recently received to cease shipments until further advised. In addition to copper, there would be in Australia by the end of March 80,000 tons of pig-lead and 500,000 tons of zinc concentrates stored and paid for by the British Government. The total value of metals and concentrates paid for by the Imperial authorities and still in Australia represented no less a sum than £7,000,000. The Commonwealth Government was advised that this condition of affairs was transitory, and that as soon as the war stocks had been consumed, sound markets would be found. The Goverment had already gone a long way to assist the copper producers.

**Dissolutions and Liquidations.**—George Schultz and Co., Ltd., 10, Arthur Street, London, E.C.—The creditors interested herein met, on 9th inst., at the offices of Messrs. W. A. Scott & Co., C.A., 50, Cannon Street, E.C. The shareholders of the company had previously passed an extraordinary resolution to the effect that it had been proved to their satisfaction that the concern could not, by reason of its liabilities, continue its business, and that it was advisable to wind up voluntarily. The shareholders also passed a resolution appointing Mr. W. A. Scott to act as liquidator. The liquidator submitted a statement of affairs, which disclosed ranking liabilities of £9,203, all of which were due to unsecured creditors. The assets were set down at £4,411, from which had to be deducted £38 for preference claims, leaving net assets of £4,373, or a deficiency of £4,830. The assets included patents, £1,124, and goodwill, £3,000. The issued share capital of the company was £4,210, and as regarded the contributories there was a deficiency of £9,040. At a forced realisation it was estimated that the assets would produce £787. At a forced realisation the patents were valued at £50, while the goodwill was written off. The company was registered on July 29th, 1912, with a nominal capital of £7,000, divided into 400 ordinary shares of £5 each and 1,000 preference shares of £5 each. In all, 722 ordinary shares and 120 preference shares had been issued. In addition to the assets shown, the company had a claim against another concern in respect of loss of profits due to a contract not being carried out. There was also a claim of £6,782 against another company. That amount would form a counter-claim against a claim which might be made against the company. The liquidator stated that at the outbreak of the war the son of the managing director of the company was acting in Manchester as agent for a firm which was said to have its headquarters in Cologne. The son joined the Army and he entered into an agreement with the company to carry on the business. The company continued the business, but a loss was made, and, finally, a controller was appointed by the Board of Trade, on the ground that the Manchester business was an enemy concern. The company resisted that claim, but the assets at Manchester were disposed of. The company claimed that they were entitled to be indemnified against loss in that direction by the firm in Cologne. After some discussion, the liquidator said he would resign if it was the wish of the creditors, and it was agreed that an application should be made to the Court for the appointment of Mr. D. F. Basden, C.A., as liquidator. The creditors are as follows:—

| | | | |
|---|---|---|---|
| Interlock Metal Hose Co. .. | £22 | Hill, W. C. .. .. .. | £73 |
| Hughes Johnson Stampings, Ltd. | 87 | Directors' Fees .. .. | 75 |
| Stewarts & Lloyds, Ltd. .. .. | 70 | Scott, D. H. .. .. .. | 79 |
| Board of Trade (Royalty Account) | 12 | Scott, G. L. .. .. .. | 225 |
| William Dawson & Sons, Ltd. .. | 14 | Manchester Corporation .. | 36 |
| Scott, W. A., & Co. .. .. .. | 17 | Board of Trade .. .. | 5,446 |
| Mackie & Watts .. .. .. | 70 | Public Trustee .. .. | 2,306 |

Westinghouse Electric Co., Ltd. — Winding-up voluntarily. Liquidator, Mr. A. E. Scanes. Meeting of creditors, May 20th, at 2, Norfolk Street, Strand, W.C.

Cramp's Patent Reversible Turbine, Ltd.—Winding-up voluntarily. Liquidator, Mr. F. W. Steel, 5, Copthall Buildings, London, E.C. Meeting of creditors, May 22nd. Claims to be sent to the liquidator by May 21st.

Monometer Manufacturing Co., Ltd.—Meeting, June 11th, at 26, Corporation Street, Birmingham, to hear an account of the winding-up from the liquidators (Messrs. H. T. Ledsam and G. G. Poppleton).

Troughton & Young, electrical and general engineers, Park Mansions Arcade, Knightsbridge, London, S.W.—Messrs. J. A. Troughton and H. T. Young dissolved partnership in July, 1918, by effluxion of time. Mr. H. T. Young will attend to debts and continue the business under the same style and at the same address.

**Surplus Government Property.**—It is announced that in order to interest export houses in the sale abroad of surplus Government property and to deal readily and on the spot with inquiries from such firms a city branch of the Surplus Government Property Disposals Board has been set up under the direction of Sir Sydney Henn, K.B.E., at Holland House, 32, Bury Street, E.C.

**Resumption of Trade Between Japan and Germany.**—According to the Bâle *Anzeiger*, a Japanese Commission, representing the foreign trade of their country, recently left Tokio for Italy, charged with the duty of making a trade compact with Austria, Hungary and Germany. Reuter's correspondent informs us that the Japanese will send finished goods and raw materials, principally copper, to Germany. Regarding copper, the question of the German contracts in America is again becoming acute. Japan expects to receive in return from Germany chemicals and electrical goods.—*Oesterreichische Chemiker-Zeitung*, March 15th, 1919.

**Bankruptcy Proceedings.**—W. J. McCombe, tramway manager, Berkeley House, Princes Avenue, Kingston-upon-Hull. Receiving order made May 5th, on debtor's own petition. First meeting, May 22nd; public examination, June 16th; both at Hull.

## LIGHTING AND POWER NOTES.

**Accrington.**—Year's Working.—At the last meeting of the T.C., it was reported that there would be a loss on the year's working of the department of about £1,698, and that it would probably be necessary to increase the charges for electricity. It was intimated that there was a probability that the application for borrowing powers for electricity extensions would not be successful, and that a new super-power station would possibly be erected at Preston, on the banks of the Ribble, in the near future, and that the winter of 1921-2 might see the distribution of electricity in bulk under a national scheme, the area supplied extending from Preston to Bacup, with Accrington, as a distributing centre.

**Australia.**—E.L. Schemes.—Wagga (N.S.W.) has instructed Mr. Vormester, of Albury, to prepare plans and specifications for the town electric supply scheme, which, it is estimated, will cost £30,000. When approved tenders will be invited in England and Australia for the supply of plant. Blacktown (N.S.W.) Shire Council is considering the question of installing electricity in the shire.

It is proposed to supply electricity to the Goswells district (W.A.), which includes Waddington, Kenwick, and part of Cannington, from the City of Perth (W.A.) electricity supply. The Perth City Council has arranged to give a supply of electricity to the Queen's Park district, which embraces Welshpool, Cannington, and the frontage to the Canning River, a distance of about 10 miles. The initiation of the scheme was delayed owing to the war.

**Bath.**—Price Increase.—The E.C. recommends increased charges for lighting and power, as follows:—Private lighting, 1½d. per unit, additional to the present prices; power and heating, 2½d. per unit, subject to discount.

Loan.—The Committee is applying to the L.G.B. for powers to borrow £2,528 for new mains.

**Bolton.**—Loan Sanction.—The Corporation has received the sanction of the L.G.B. to the borrowing of £17,000, and £5,000 for prospective expenditure on electricity mains and sub-stations respectively.

**Bournemouth.**—Electricity Charges.—The Electricity Supply Co. has communicated with the Council, giving six months' notice to terminate the agreement of January, 1914.

**Brandon (Durham).**—E.L. Scheme.—The U.D.C. has decided to apply for borrowing powers for lighting the whole district with electricity, and also for authority to supply energy to private consumers.

**Brentwood.**—Proposed E.L. Scheme.—The U.D.C. has passed a resolution to the effect that an E.L. scheme would be favourably considered, and support given to an approved company, and expert advice is to be obtained and the result reported to a public meeting.

**Bridlington.**—Price Revision.—The T.C. has raised the charges for electricity for power as under:—First 250 units per quarter, 2½d.; 250 to 500, 2d.; 500 to 1,000, 1½d.; beyond, 1½d.

**Burnley.**—Proposed New Works.—The Town Council has confirmed the action of the Electricity Committee in instructing Mr. E. M. Lacy, consulting engineer, to advise as to the advisability of proceeding with extensions to the electricity undertaking on the present site, or alternatively as to the erection of a new generating station on a more suitable site, at a fee of 200 guineas, plus expenses.

Proposed Loan.—The Committee has decided to apply to the L.G.B. for sanction to borrow £5,000 to cover expenditure in laying mains.

**Coventry.**—Price Revision.—The Electricity Committee recommends that, as from January 1st last, the charges for electricity for power be fixed at 20 per cent. above those in force on September 30th, 1918.

**Darwen.**—Year's Working.—There was a loss of £973 on the electricity undertaking last year.

**Denbigh.**—Water Power.—The Anglesey County Council has decided to support a joint scheme for the utilisation of the water-power available on the borders of the Denbigh Asylum Estate to generate electricity for lighting and heating. Mr. S. E. Britton, of Chester, has prepared a scheme which, at a cost of about £6,000, would supply the Asylum by next winter with three and a-half times the power now generated by steam, and save 700 tons of coal. The total estimated cost would be apportioned to the respective County Councils concerned, as follows:—Denbigh, £1,893; Flint, £1,212; Anglesey, £668; Carnarvon, £1,631; Merioneth, £593.

**Dundee.**—Flood-Lighting.—Electric flood-lighting projectors were recently tested by the City Fire Brigade, Police, the Lighting Committee, and Mr. H. Richardson (city electrical engineer), and it was considered that projectors would be of great use in helping to bring fires under control.

**Durham.**—Street Lighting.—The T.C. has asked the E.L. Co. to quote terms for public lighting in competition with the Gas Co., whose contract expires on September 30th next.

**Eton.**—Street Lighting.—The U.D.C. has entered into a new contract with the Windsor Installation Co. for public lighting at £10 a year for clusters of three 200-c.p. lamps, and £3 10s. each for 25-c.p. lamps.

**Hereford.**—Lighting of Rural Areas.—The T.C. proposes to extend the area of supply into the rural areas, and has asked for an initial loan of £13,000, and for an indemnity in respect of capital charges on plant installed during the war, to provide energy for national purposes. A conference is to be held with the rural authorities, and their co-operation in the scheme solicited.

**Heywood.**—Year's Working.—There was a loss of £290 on the last year's working of the Corporation electricity undertaking. The output reached 1,404,299 units, an increase on the previous year.

**Kingston-upon-Thames.**—Year's Working.—The report of the year's working to March 31st, 1918, states that after payment of all charges, including interest and repayment, the net deficit was £1,763, as against a deficit of £6,790 in 1917. Notwithstanding the high prices of coal and fuel oil, the cost of fuel per unit sold decreased from 1·752d. to 1·584d., partly due to increased output and partly on account of the larger proportion of units generated by the Diesel engines. During the year the steam plant generated 939,122 units at a fuel cost of £9,183, or 2·346d. per unit sold, while the Diesel plant generated 746,913 units at a fuel cost of £1,942, or 0·623d. per unit sold.

**Lancaster.**—Year's Working.—For the year ended March, 1918, the number of units sold totalled 936,844 and the working costs 2·50d. per unit. Gross profit was £2,516; after payment of interest and special expenditure, £1,320, and loan instalment, £1,851, there was a deficit on the year's working of £655.

**Lincolnshire.**—Plant Extension.—It is reported that electrical plant is to be laid down at Keadby to provide a supply of energy to the North Lincolnshire ironstone area and the South Yorkshire coalfields.

**London.**—Ilford.—Price Revision.—The Electricity Committee recommends the following increased charges for lighting and power:—Rateable value, 12½ + 75 per cent. + 2d.; ordinary lighting, 7d. per unit; maximum demand, 8d. and 5d. per unit; slot meters, 7½d. per unit; power, maximum demand system, 5d. and 3d.; large consumers, 5d. per unit, to 2½d. per unit; heating, &c., 3d. per unit; special purposes, kinemas, vehicle charging, photo lamps, bulk supply, &c., addition of 25 per cent., making a total increase of 100 per cent.; minimum account, 5s. per quarter.

Hackney.—The Electricity Committee recommends that the Council grant plenary powers to the representatives of the I.M.E.A. acting on the Joint Industrial Council—Electricity Supply Industry; also that authority be granted to it to exercise such powers when negotiating outside the Industrial Council with any body of workers or association not having representation thereon, and also that a communication be addressed to the Ministry of Labour stating that in the opinion of the Council the Wages Conference of Local Authorities, Greater London, should be represented on the Joint Industrial Council in dealing with all matters in connection with the electric supply industry.

Refuse Destructor Works.—The Establishment and General Purposes Committee, recommends that the whole of the supervision and management of the refuse destructor undertaking should be transferred from the Electricity Committee to the Public Health Committee.

Flooding of Works.—The borough electrical engineer has reported to the Electricity Committee on the recent flooding of the works due to the overflow of the River Lea. On February 18th the river rose rapidly, and for the first time in the history of the works, threatened to innundate the engine room basements, which contain the whole of the condensing plant. A total shut down of the works was narrowly averted on February 19th by the help of the fire brigade. The L.C.C. account for services rendered for pumping was £259.

**Loughborough.**—Price Revision.—In reply to the protests against the increased electricity rates, it was explained that the works costs had increased by £4,050, and the additional charges of 20 per cent. for lighting, and 25 per cent. for power, making 65 per cent. for lighting, and 80 per cent. for power, would only bring in £4,100.

**Manchester.**—Housing Schemes.—The Corporation Housing Committee has asked the City architect to consider the report upon the use of electricity for illuminating purposes in the houses to be erected in connection with housing schemes.

**Morley.**—Year's Working.—There was a deficit of £1,758 on the electricity department for the year 1918.

**Motherwell.**—Price Revision.—The T.C. has adopted the following increases in the charges for electricity for power and lighting:—Cooking and heating, ½d. per unit; kinemas, ¼d.; collieries, ·05d.; public lighting, 50 per cent. in place of 15 per cent.; works lighting, 2d., instead of 1½d.; power consumers, up to 2,500 units per term, 2d. instead of 1½d.; hire of motors, 50 per cent. increase.

**Rathmines.**—Loan Application.—The U.D.C. has decided to apply to the L.G.B. (Ireland) for sanction to a loan of £10,000 for the extension of mains and other purposes in connection with the electric lighting of the township.

**Rothwell.**—Street Lighting.—The U.D.C. has decided to ask the Yorkshire Electric Power Co., Ltd., for terms for the supply of electricity for the street lamps in the districts where mains are already laid.

**Runcorn.**—Town Hall Lighting.—The U.D.C. has decided to have E.L. installed at the library and Town Hall, at a cost of £158.

**St. Helens.**—Loan Application.—The Electricity Committee has decided to apply to the L.G.B. for sanction to borrow £2,650 for electrical purposes.

**Stroud (Glos.).**—Proposed Generating Station.—The Electric Supply Co. has applied to the B. of T. for consent to erect a generating station at Cainscross.

**Sunderland.**—New Plant.—At the Corporation's power station at Hylton Road a 7,500-kw. Willans-G.E.C. turbo-generator is being installed, together with two large water-tube boilers, with chain-grate mechanical stokers, superheaters and economisers. A new cooling tower also is being built. The cost of the new plant will be approximately £90,000.

**Walsall.**—Bill.—The T.C. has confirmed the decision to promote a Bill in Parliament for obtaining additional powers with regard to the supply of electricity.

**Walthamstow.**—Loan Application.—The E.C. has recommended that application be made to the L.G.B. for sanction to borrow £32,975, the estimated cost of installing one 3,000-3,500-kw., three-phase turbo-alternator, complete with condensing plant, circulating pipes, switchgear, and the necessary machine and auxiliary-plant cables, and of one 20-ton engine-room crane.

**Workington.**—E.L. Bill.—A public meeting has approved the Corporation's application in the present session of Parliament, for an Act giving powers with regard to the supply of electricity.

**Worthing.**—Loan Sanction.—The T.C. has received the sanction of the L.G.B. to borrow £8,896 for a Diesel engine and dynamo, £496 for a balancing transformer with foundations, switchgear, &c., £3,550 for mains, and £3,500 for services.

## TRAMWAY AND RAILWAY NOTES.

**Australia.**—Railway Workshops Electrification.—Mr. O. J. Rankin, works manager of the South Australian Railway workshops at Islington, has reported that the cost of equipping the shops with electrical drive would be £26,400, using the existing main shafting for the grouped machines, and independent motors for the larger machines, power to be obtained from the Adelaide Tramways Trust at 11,000 volts and transformed at Islington. The report has been submitted to Mr. P. A. Anthony, who recently made investigations as to the management of the railways.—*Tenders.*

**Bradford.**—New Tramway Cars.—The Tramways Committee has decided to order 26 additional sets of car motors for immediate delivery, and it is directed that these new cars be fitted with Spencer-Dawson patent oil-power brakes.

**Canada.**—Wages.—The employés of the Toronto tramways are demanding 55 cents (2s. 3½d.) an hour, an eight-hour day, and overtime pay. The increases would cost £400,000 annually.

According to the daily Press, the Montreal harbour railway system is being electrified.

**Chesterfield.**—The B. of T. has extended the time till August, 1920, for the completion of the overhead equipment, &c., for working trolley vehicles authorised under the Chesterfield Corporation Railless Traction Act, 1913, and until July, 1920, for the completion of certain sections of the tramways authorised in 1914.

**Colne.**—Year's Working.—The annual report on the working of the Corporation tramway department shows a loss on the past year of £3,004, compared with an estimated loss of £1,825. The manager attributes the excess deficit to increased costs of wages and electricity, amounting to £2,070.

**Darwen.**—Year's Working.—There was a loss of £75 on the tramway undertaking for the past year.

**Doncaster.**—The Electricity and Tramways Committee has decided to postpone the application to the Light Railways Commissioners for sanction to construct a line to Rossington.

**Ealing.**—Reconstruction.—The L.U.T. track is to be entirely reconstructed; the centre standards are to be removed and placed at the side of the road, and the rails are to be laid nearer the centre, so as to leave a wider carriage-way on either side. The cost of the removal of the centre standards is estimated at £4,200 and the rearrangement of the electric lighting at £2,500; the alteration of the track is estimated at £35,000.

**Hastings.**—Overhead System.—The Tramway Co. has applied to the T.C. for support to a scheme for replacing the surface contact system on the sea front by overhead lines, and a Committee has been appointed to go into the matter.

**Heywood.**—Year's Working.—The profit on the Corporation tramways for the past year amounted to £944. Before the war the working costs totalled £7,936; last year they amounted to £14,440. It is estimated that the reduction of hours will add an extra £1,400 to £1,500 to the working expenses.

**Jamaica.**—Railway Electrification.—The improvement of the State Railways is under consideration and investigations are being carried out with a view to the transport of market produce. The Government is also considering a scheme of electrification, and a sum of £1,000 has been set apart for inquiry in this direction. Recently a gentleman connected with a large electric supply plant on the Clyde, while on a visit to Jamaica, went into the scheme. It is proposed to utilise water power, of which there is an abundance in the island, for the generation of electricity.

**Lincoln.**—Loan Sanction.—The Electricity and Tramways Committee has received sanction to borrow £6,000 for the purchase of additional tramway-cars.

**London.**—Hornsey.—Electric Vehicles.—The T.C. is to spend £11,500 on six electric vehicles for the collection of house and trade refuse.

A Highways Committee report states that 1,500 men are now repairing L.C.C. tramway track. The supply of materials is not yet satisfactory.

**Mansfield.**—Light Railway Extensions.—The Light Railway Commissioners on May 7th held an inquiry into the application of the Light Railway Co. to extend the lines to Forest Town, Clipstone, and Rainworth, a total of 6¼ miles. The T.C. supported the application, which was opposed by the local railway companies.

**Northampton.**—Bulk Supply.—The T.C. has accepted the recommendation of the Tramways Committee to cease generating electricity for the tramways, and, instead, to purchase a bulk supply for five years from the electric light company at 1·4d. per unit. Energy purchased by the Corporation of late has cost over 2d. per unit. A saving of nearly £3,000 per year is estimated to result from the change.

**Plymouth.**—Year's Working.—The annual report on the Corporation tramways to March 31st last shows that the total number of passengers carried was 28,438,343, compared with 26,187,549 in the previous year. The total income amounted to £121,047; after deducting working expenses the gross profit totalled £33,024, and, after payment of capital charges, the net surplus remaining was £10,679, from which the Committee has decided to apply £6,000 to working capital and place the balance (£4,679) to the reserve fund. The receipts per car-mile averaged 20·34d., against 16·34d. To meet the additional expenditure involved by the adoption of the 48-hours week, the Tramways Committee has decided to double the fares on the longer routes.

**Portsmouth.**—Extensions.—The Corporation proposes laying a further 3 miles of tramway at a cost of £65,000.

**Sandgate.**—Resumed Service.—The Sandgate-Hythe tramway service is to be resumed at Whitsuntide.

**Shipley.**—Increased Rental.—The U.D.C. recently applied to the Bradford Corporation for an increased rental for the tramway tracks owned by the Council and leased to the Bradford Corporation. The Corporation suggested that the Council should consider selling the tracks. The Council, last week, declined to entertain this idea, and decided to press for increased rental.

**St. Helens.**—Purchase of Cars.—The Tramways Committee has decided, on behalf of the Corporation, which is taking over the local tramway service in September, to purchase 36 tramcars from the existing company.

Loan Application.—The Tramways Committee has also decided to make application to the B. of T. for sanction to borrow £25,000 for tramway purposes.

## TELEGRAPH AND TELEPHONE NOTES.

**Australia.**—After the Commonwealth Naval Department, the Defence Department, and the Postmaster-General's Department had considered an offer made by the Marconi Co. to establish wireless telegraph stations in Australia for international messages, the Commonwealth Government decided to give no rights to private companies. Experts are to report on the technical and financial sides of the proposition.

**Automatic Telephones.**—Contracts for buildings for an automatic telephone exchange at Sheffield are to be placed immediately.

**British Submarine Cable Work during the War.**—The full story cannot yet be told of the remarkable achievements of submarine telegraph cable-laying and repairing authorities during the past five years. The Telegraph Construction and Maintenance Co., in addition to manufacturing 20,000 miles of trench telephone cable, mostly with several conductors, made 19,000 miles of submarine cable, and its ships were actively engaged, generally on most dangerous work, laying, repairing, and diverting cables. The cable steamer *Telconia* made 75 repairs to cables and laid 24 new ones around the English and Irish coasts.

**Cable Delays.**—The P.M.G. announces that, in future, commercial cables are not to be delayed in favour of Government messages, unless the latter are really urgent.

Certain important cables which were interrupted have lately been repaired; but the American Pacific Cable is still interrupted, and this throws extra work on the British cables in that region. It is expected that the cable will be repaired in a few days' time.

Some months ago the War Office invited the Chambers of Commerce to suggest what codes might be added to the list of those already authorised. The Posts and Telegraphs Committee of the London Chamber advocated complete freedom in the use of codes, and submitted a list of codes which it suggested should be authorised. The Army Council last month regretted that the proposals involved difficulties which precluded their adoption at the present stage of the cable censorship.

**China.**—Communication between Peking and the outside world is broken, except to Siberia. There is severe rioting at Peking, and all wires have been cut.

**Post Office Deficit.**—In the House of Commons, on May 7th, Mr. Illingworth said the deficit of £274,000 upon P.O. services was due principally to the war bonus and the general rise in costs. The sum of £3,430,000 to be raised by borrowing was capital expenditure upon new telephone works and upon the Post Office (London) Railway, and was authorised by Acts of Parliament. The war bonus was estimated at £14,000,000 per annum, and so long as it continued at its present figure he feared the Post Office must be regarded as a non-revenue-producing department.—*The Times.*

**P.O. Employés.**—At the annual conference of the Postal and Telegraph Clerks' Association, at Blackpool, last week, the president stated that the Association was now ready to use the strike weapon, and that amalgamation with other organisations of P.O. workers was the subject of a ballot. The Association had obtained a 60 per cent. war bonus on the average, but that was not enough. On a proposition to confer rights on wireless operators, the Executive announced that the Government was about to nationalise wireless systems.

**Wireless Stations Arbitration.**—Mr. Justice A. T. Lawrence was to sit yesterday to assess the damages payable by the Crown to the Marconi Co., for breach of agreement for the construction by the company of a chain of six Empire wireless stations.

## CONTRACTS OPEN AND CLOSED.

(*The date given in parentheses at the end of the paragraph indicates the issue of the* ELECTRICAL REVIEW *in which the "Official Notice" appeared.*)

### OPEN.

**Australia.**—BRISBANE.—June 18th. Brisbane City Electric Light Co. Supply of rotary converters (specification 10s. 6d.). Offices of the company at Brisbane.—*Tenders.*

SYDNEY.—June 9th. City Council. Supply and erection of power-house switchgear. Specifications from Electric Lighting Department, Town Hall, Sydney.*

June 23rd.—Municipal Council. One 60-ton electrically-driven overhead travelling crane. Electric Lighting Department, Town Hall, Sydney.*

**Bury.**—June 6th. Electricity Department. One 6,000-KW. steam turbo-alternator and exciter, with surface condenser and air circulating pumps. (See this issue.)

**Ilkley.**—May 20th. U.D.C. Supply of one 3½-ton electric hand-tipping wagon. Mr. G. A. Waite, Engineer and Surveyor, Town Hall.

**London.**—L.C.C. May 27th. Tramways Department. 2,000 tons of standard steel girder tramway track rails with fastenings, and alternatively, about 4,000 tons of standard track rails, lipless track rails and renewable guard rails. Specification (£2) from the Chief Engineer, County Hall, Spring Gardens.

**Maidstone.**—May 19th. Electricity Committee. 1,050 yd. '15 sq. in. and 1,260 yd. '05 sq. in. E.H.T. cable. Mr. E. E. Hoadley, Engineer and Manager, Electricity Works.

**Manchester.**—May 28th. Electricity Committee. Two 4,000-K.V.A., three-phase static transformers for Stuart Street generating station. Mr. F. K. Hughes, Secretary, Electricity Department, Town Hall.

June 4th. Electricity Committee. Supply of cable for 12 months. (See this issue.)

**Natal.**—May 20th. Corporation. 12 miles steel girder rails (95 lb. per yd.) with fishplates, bolts and nuts, and 4,300 tie bars, and 1,500 copper rail bonds and 300 cross bonds. Webster, Steel & Co., Agents to the Durban Corporation, 5, East India Avenue, E.C.

**Oldham.**—May 27th. Tramways Department. 12 double-deck top-covered tramcars, with or without vestibules, complete with trucks; also 12 complete 40-H.P. electrical equipments for the above. (See this issue.)

*A copy can be seen at the Inquiry Office of the Department of Overseas Trade (Development & Intelligence), London.

### CLOSED.

**Bolton.**—Electricity Committee :—

Supply of cable during the next 12 months.—B. I. & Helsby Cables, Ltd.; I. Frankenburg & Sons, Ltd.; W. T. Henley's Telegraph Works Co., Limited.

Tramways Committee :—

Supply of a 36-in. plain horizontal milling machine, complete with motor and starter.—Smith & Coventry, Ltd.

**Dartford.**—U.D.C. Cables, feeder control units and meters for the supply of Vickers, Ltd., Joyce Green. Johnson and Phillips, Ltd., £3,152.

**Dublin.**—Corporation. One 5,000-KW. turbo-alternator and condensing plant :—

| | |
|---|---|
| General Electric Co., Ltd. | £42,212 |
| **Ateliers de Construction Oerlikon (accepted)** | **42,680** |
| Brown, Boveri & Co. | 42,697 |
| Richardsons, Westgarth & Co. | 43,216 |
| British Westinghouse Co. | 43,342 |
| Dick, Kerr & Co. | 43,460 |
| Bellliss & Morcom | 43,533 |
| C. A. Parsons & Co. | 43,575 |
| British Thomson-Houston Co. | 43,646 |

This is the third order for turbo-alternating plant placed with the Oerlikon Co. by the Dublin Corporation.

**Eastbourne.**—Corporation Electricity Department :—

John Thompson Water-Tube Boilers, Ltd.—One boiler, having an evaporative capacity of 26,000 lb. of steam per hour from and at 212° F., fitted with underfeed travelling-grate stokers and Ferguson superheaters, £7,400.

**Leeds.**—Tramways Committee. Recommended :—

Rotary converter, £2,586.—British Westinghouse E. & M. Co., Ltd.

**London.**—L.C.C. Highways Committee. Tenders accepted during the three months ended March 31st, 1919 :—

Metallic filament traction lamps (schedule 17a).—B.T.H. Co., Ltd.; Siemens Bros. Dynamo Works, Ltd.

**Winchester.**—T.C. :—

Material for converting existing stoker on the large boiler at the electricity works into a mechanical stoker.—Babcock & Wilcox, Ltd., £200.

## FORTHCOMING EVENTS.

**Junior Institution of Engineers.**—Friday, May 16th. At 7.30 p.m. At 39, Victoria Street, S.W. Paper on "Notched Bar Tests," by Major P. Philpot, R.A.F.

**(North-Eastern Section).**—Tuesday, May 20th. At 7.15 p.m. At the Mining Institute, Newcastle-on-Tyne. Paper on "Gas and Oil Engines," by Mr. Tree.

**Institute of Metals.**—Monday, May 19th. At 8 p.m. At Caxton Hall, Westminster, S.W. Ninth annual May lecture on "Radio-Activity," by Prof. F. Soddy, F.R.S.

**Industrial Reconstruction Council.**—Tuesday, May 20th. At 6 p.m. At the Institute of Journalists, Tudor Street, E.C. Conference on "The Industrial Life of the Coal Miner," to be opened by Mr. J. Walton, M.P.

**Labour Co-partnership Association.**—Thursday, May 22nd. At 3 p.m. At the Hoare Memorial Hall of the Church House, Gt. Smith Street, Westminster. Annual meeting. Address by the Rt. Hon. J. R. Clynes, M.P.

**Institution of Electrical Engineers.**—Thursday, May 22nd. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Paper on "Electrical Phenomena Occurring at High Atmospheric Levels," by Dr. S. Chapman.

**(South-Midland Centre).**—Wednesday, May 21st. At the University, Edmund Street, Birmingham. Ordinary meeting.

## NOTES.

**Stealing Electric Lamps.**—At Haslingden, last week, a 17-year-old youth was fined £1 for stealing six electric lamps from the Weavers' Institute, and three from the Free Library. There had been complaints of thefts of lamps from public buildings in the town. In this case the youth sold three of the lamps for 6s.

**The Protection of Oil Tanks from Lightning.**—A pamphlet issued by the Petroleum Executive states that experience proves that lightning conductors should not be provided for the protection of oil tanks; the tanks, being metal structures, efficiently protect the contents, and the addition of lightning conductors might in some cases increase the risk of ignition of the vapours from the oil.

**A City Electrified.**—Contractors and central stations in more than 400 cities in the United States have signified their willingness to co-operate with the Society for Electrical Development in a nation-wide house-wiring campaign. "Electrify Your Home." Of all the 11,000 contractors and central stations to whom the story of the campaign was sent, only one flatly said, "You can't do anything for us"—namely, Pasadena, California. The Municipal Electric Lighting Department stated that every house in Pasadena was wired and connected; population, 42,000; electric meters connected, 15,600. Here is the ideal for our Electrical Development Association to focus its attention upon.

**The Food Ministry Interested in Electrical Development.**—In view of the recent formation of the Electrical Development Association, it is interesting to learn that, in addition to the Board of Trade, the Ministry of Ways and Communications, the Prime Minister, the Home Secretary, and other eminent authorities, the Ministry of Food has taken notice of electricity supply.

We learn that Mr. George W. Greenwood, British Minister of Food, has written to Mr. J. M. Wakeman, general manager of U.S. Society for Electrical Development, commending the Society's campaigns for broader applications of electric service and requesting, for official purposes, copies of all material used. Mr. Greenwood's letter states that "in the reconstruction period following upon the war, the Ministry of Health and the Ministry of Reconstruction are both advocating a wide extension of the use of electricity in all forms of industry and also in the home for domestic purposes, such as cooking, heating, and lighting."

He understands that the Society has been established primarily with the object of popularising the uses of electricity in the United States, and has conducted some very efficient campaigns in this direction. He therefore asks to be favoured with copies of pamphlets, literature, newspaper articles, advertisements, and any other material—such as photographs, &c.—in order that he may submit them to the proper official quarter.

Mr. Greenwood's action is highly commendable, though we are somewhat perplexed by the conclusion of his letter. Which is the "proper official quarter"?

**Gibraltar Straits Tunnel.**—A Committee of leading Spanish financiers has been formed in Barcelona to further a scheme for a tunnel under the Straits of Gibraltar, drawn up by Colonel Rubio y Bellve, who has obtained from the Government the necessary authorisation for carrying out soundings and other preliminary work. The tunnel would be over 20 miles long.

**German Nitrogen Syndicate.**—In view of the opposition of the Reichstag to a commercial monopoly of nitrogen, the Treasury has proceeded to create a syndicate which is to deal with all the nitrogen produced in Germany. The Government has not only already invested enormous sums in the industry, but has now also secured a controlling interest in the management of the syndicate and the fixing of the price. It is proposed later on to unite all the consumers in a single group. The whole scheme has been laid before the National Assembly for approval.

**The I.M.E.A. Annual Convention: Alteration of Dates.**—Owing to difficulties concerned with catering when the Association visits Ipswich on the first day of the Convention, it has been necessary to alter the dates for the Convention to Wednesday, Thursday, and Friday, June 18th, 19th, and 20th, instead of the dates previously announced. The Felixstowe hotels have been notified of the altered dates. A revised programme will shortly be issued to members.

**Irish Water-Power.**—At the Dublin Rotary Club, Mr. Marshall Harriss, general manager, Dublin United Electric Tramways, read a paper on Irish rivers as aids to the distribution of cheap electrical power, and alluded to the important water-power development now being considered by the directors of the Dublin and Lucan Electric Railway. It was proposed, he said, to utilise the fall on the River Liffey, available above Leixlip, acquiring the site, including the water rights on both sides of the river.

**Electricity for Farmers.**—Dr. J. F. Crowley, M.I.E.E., lectured to the Tunbridge Wells Farmers' Club recently on "The Uses of Electricity in Agriculture." Dr. Crowley said electricity was used in the production of artificial fertilisers, more particularly through the fixation of atmospheric nitrogen, and its direct application to growing crops was being investigated by a special scientific Committee. The use of machinery reduced labour cost, and enabled more work to be done in a given time, and, in addition, the elimination of animal power from farm work enabled millions of acres at present devoted to the raising of food for fodder to be devoted to more directly productive purposes.

**The Inns of Court Regimental Association.**—The task of finding employment for ex-officers looms large in the public mind to-day. With the revival of industry which is now taking place, opportunities should be many, and, for the fully qualified men, the problem depends for its solution on the provision of an efficient medium by means of which employers can get in touch with candidates of the requisite qualifications. The Inns of Court Regimental Association, which has a large register of ex-officers, provides such a medium, and employers and others, who have vacancies or openings for men of the officer type, should notify this Association of their requirements. The Association has already been successful in placing many of its members in appointments ranging from mere clerical posts to partnerships and directorships where capital is brought in. No fees are charged, and the increasing co-operation which is now being obtained by it from employers is, no doubt, due to the personal methods which it employs, and its capacity for fitting the right man for the opportunity.

Communications should be sent to the Secretary, Inns of Court Regimental Association, 10, Stone Buildings, Lincoln's Inn, London, W.C. 2.

**London Electrical Engineers, R.E. (T.F.)**—The officers of the London Electrical Engineers, R.E. (T.F.), will hold a dinner at the Restaurant Frascati, on Thursday, June 12th, at 7.15 for 7.30 p.m. Any officer able to attend should communicate with Captain F. Masters, at 46, Regency Street, London, S.W. 1, as soon as possible, the accommodation being limited.

**Patents in War-time.**—With a view to concerted action for the extension of the life of patents, Messrs. Briggs & Son, 16, John Street, W.C. 1, invite patentees to communicate with them.

**Fuel Control.**—The Controller of Coal Mines announces that until further notice the supply and consumption of any form of anthracite coal is free from restriction under the Household Fuel and Lighting Order, 1918, and need not be recorded against the allowances of consumers. The price remains under control. Otherwise the provisions of the Order in respect of coal, coke, gas, and electricity still apply, and will continue to do so until the coming into operation of the Order proposed for July 1st.

**American Electric Furnace Association.**—Important steps were taken to promote the use of electric furnace products at a meeting held at Niagara Falls, N.Y., on March 21st. It was asserted that all interested in the matter could join together on a common basis to extend the use of electric furnaces and their quality products. A start was made in an organised way to carry out these plans. A permanent organisation, to be called the Electric Furnace Association, was created, with Mr. Acheson Smith (Acheson Graphite Co., Niagara Falls) as president, and M. C. G. Schluederberg (Westinghouse Electric Manufacturing Co., Pittsburg) as secretary. The president was authorised to get in touch with all companies and persons who should be interested in joining the organisation, and to arrange an early meeting when completed publicity plans could be discussed. The different Committees were instructed to perfect reports which could serve as a basis for constructive work.

**Eliminating Telephone Line Interference.**—The Seattle Municipal Lighting Department has developed a satisfactory means of protecting telephones from inductive interference on the city's 40-mile transmission line. The telephone wires are strung 15 ft. (4·5 m.) below the power wires, which consist of a 60,000-volt star-connected circuit with earthed neutral. The plan which has succeeded after the failure of several other attempts, says the *Electrical World*, has been to install on all telephone services a special closed-core transformer, in which a heavy brass sheath separates primary and secondary coils. The edges of the sheath are overlapped, but insulated, to prevent its becoming a secondary of one turn. The sheath is earthed, as is also the secondary of the transformer. This design is the same as that used on small power transformers, which step down from 60,000 to 125 and 250 volts for the accommodation of patrolmen along the right-of-way. With this arrangement no static impulse can pass to the telephone, and the operator is protected in case a H.T. conductor should break and fall over the telephone line. No insulated stool is used for H.T. telephone operators. A telephone was manufactured, in which two contacts are used, one on each side of the diaphragm. The two paths of the current being wound differentially in the repeating coil, a constant current is not obstructed, but is shifted from one wire to the other with the vibrations of the diaphragm, thus permitting the use of high currents. The transmitter at the power house is being successfully operated from the current of one of the 125-volt exciters through a variable resistance, which allows a larger current to be maintained when the telephone lines are disturbed. In this way there can be maintained a much larger talking current in proportion to the induced current from the power wires. If the talking is too loud in the receiver, a variable-capacity reactor or resister between the telephone lines can be used to reduce the volume. This reduces the talking current and the interfering currents in a virtually proportional degree. On account of the number of telephones on the line, a stronger ringer was necessary, and this requirement has been met by gearing together two ordinary magnetos connected in series.

**The A.S.E. Secretaryship.**—A Manchester paper reports that Mr. James Kaylor, of Manchester, has been nominated for the position of general secretary of the Amalgamated Society of Engineers, rendered vacant by the election of Mr. R. Young to Parliament as the Member for Newton-le-Willows.

**Institution and Lecture Notes.—Institution of Electrical Engineers.**—On Monday last the third "informal meeting" took place, Mr. F. Pooley presiding. The attendance was much less than on the previous occasions, and several members drew attention to the desirability of opening the meetings earlier in the evening. Mr. W. E. Bradshaw opened the discussion on "The Regulations Issued by Electricity Supply Undertakings," referring, first, to the early days of electricity supply, and to the development of the Wiring Rules of the I.E.E. He then proceeded to discuss the article by Mr. C. A. Baker which appeared in the ELECTRICAL REVIEW of April 18th and 25th, and the leader in the latter issue, maintaining that the formulation and enforcement of regulations by the supply authorities was very necessary to the safety of the public. As examples of rules backed by legal authority, he cited the Home Office Rules for Factories and Workshops, and the regulations for the use of electricity in kinematograph theatres and other places of entertainment; he also gave instances showing that bad wiring was still met with, and stated that, far from being deterred from applying for a supply of electricity by the regulations of the supply authorities, the public were eager to obtain it.

A spirited discussion followed, in which both sides of the question were well represented. Amongst the points that were raised were the desirability of obtaining for the I.E.E. Wiring Rules the force of legal sanction; the need for the registration of wiremen; the question whether kinematograph motor-generators should be supplied at power or lighting rates; and the frequent disregard of some of the Home Office Rules.

Referring to the failure of the projected visits to works for want of support, the chairman announced that the Committee had under consideration a visit to the National Physical Laboratory on a Saturday morning in the summer, followed by a trip up the Thames, in which ladies could take part.

The Committee of the WESTERN CENTRE has had under consideration the advisability of holding meetings outside of Bristol and Cardiff, so that members not conveniently placed with regard to these Centres may have an opportunity of enjoying the privileges of the Institution. Inquiries are being made to ascertain whether sufficient support would be forthcoming to justify the inclusion in the programme for the Session 1919-20 of a meeting at either Exeter or Plymouth, and one at Swansea.

The Committee of the SCOTTISH CENTRE states that the special meeting which will be held at Aberdeen on Friday, June 6th, is intended to take the place of the summer outing. Ladies and other friends will be welcomed, and visitors have been invited by the Electricity Committee of the Aberdeen Corporation to luncheon at the Art Gallery. After a visit to the Fish Market, at 8 a.m., there will be a general meeting at the Town Hall, and a welcome to the Institution by the Lord Provost, followed by a lecture by Prof. Magnus Maclean. The President of the Institution is expected to be present, and to deliver an address. After lunch there will be visits to works and places of interest, including the Donside Paper Works, the Rubislaw Quarries, and the electricity works, where tea will be served. Mr. Alex. Gardner, of the Corporation Electricity Department, Aberdeen, will act as honorary secretary for this meeting.

A complimentary dinner was given at Princes Restaurant, on Monday, May 12th, to General Ferrié, C.M.G., LL.D., Technical Director of the French Wireless Service, by members of the Council and of the Wireless Committee of the Institution of Electrical Engineers. Mr. C. H. Wordingham, C.B.E., President of the Institution, was in the chair. After the healths of the King and the President of the French Republic had been drunk, Mr. Wordingham proposed the health of the guest of the evening, and was followed by Dr. W. H. Eccles. In replying, General Ferrié gave an interesting account of the great part which wireless telegraphy had played in the war.

**Society of Engineers (Incorporated).**—In compliance with a suggestion made by the Ministry of Labour (Appointments Department), the library and reading room of the Society, 17, Victoria Street, Westminster, S.W. 1, have been placed at the disposal of officers who are looking out for appointments in the engineering and allied professions. All such officers are also cordially invited to attend the ordinary meetings of the Society, particulars of which may be obtained on application to the Secretary.

**North-East Coast Institution of Engineers and Shipbuilders.**—The Institution has arranged to hold a summer meeting at Newcastle-on-Tyne on July 9th-11th, when diplomas of honorary fellowship will be presented to Marshal Foch, Sir David Beatty, Sir Douglas Haig, Lord Weir, Sir Joseph Maclay, and Lady Parsons. The papers to be read include: "Limits of Thermal Efficiency in Diesel and other Internal-Combustion Engines," by Sir Dugald Clerk; "Ship Repairing during the War," by Messrs. M. C. James and Launcelot E. Smith; and "Transmission of Power," by Mr. G. Constantinesco.

**London Association of Foremen Engineers.**—On May 3rd the Association held its Sixty-Sixth Anniversary Festival at Cannon Street Hotel. Mr. Douglas Vickers, M.P., presided, and the guests numbered between 500 and 600.

After the usual loyal toasts, Sir Hamar Greenwood, M.P., proposed the health of "The Imperial Forces."

The Right Hon. T. J. Macnamara, M.P., in responding, said that the hand of the engineer was shown in every feature affecting the prosecution of the war. In no previous war had the knowledge and skill of the engineer been so vital an element of victory.

The Chairman, proposing "Prosperity to the Association," said he was sorry, looking to the future, he could not promise engineers a very easy time. He was afraid they would have to face very nearly the same conditions that they had four or five years ago, when they were constructing for the war; now they would have to construct for the works of peace, and that would be no easy task. Employers would have to take the men very much more into their confidence than they had done. He had, however, every confidence in the future, for he felt that employers could appeal to the men and get them to understand that their interests were identical. An increased output was most essential if the country was to hold its own, and he looked to that with the greatest hope, because he had confidence in the race to which he was proud to belong.

Mr. James Harrington (Secretary and Past-President) responding, said the care which was always taken as to the qualifications of applicants for membership was now being fully justified; they had only 5 per cent. of their members unemployed, and only one man was receiving assistance on account of unemployment. A sum of £540 had been contributed to the Association's superannuation fund.

**Institution of Municipal and County Engineers.**—The Institution visited Bournemouth on Friday and Saturday last. In the course of the proceedings, Mr. Ignatius Bulfin, tramway general manager, read a paper on "The Corporation Tramways," and on Saturday he conducted several demonstrations at the depôt. The first was concerned with the Sandberg sorbitic treatment of rails *in situ*, which is being tried over a mile of track in Bournemouth. A second demonstration was the cutting of a piece of manganese steel rail by the oxy-acetylene flame; and a third, the electric welding of joints. The demonstrations were followed with great interest.

GAS *v.* ELECTRICITY.—Lecturing at King's College, London, on May 3rd, Dr. W. T. Gordon said there was much talk about using our coal supply for electric power purposes, but there was a great loss in energy when coal was used in that way. A much more economical way was to use gas. On the other hand, gas was much more dangerous in certain industries than electric power, and it might be that electrical power for certain definite purposes was better.

**Educational.**—EDINBURGH UNIVERSITY.—A site of 115 acres has been purchased by the University, to provide for the erection of chemical and other science laboratories.

UNIVERSITY OF LONDON.—The hon. treasurers of the Ramsay Memorial Fund have now received promises and donations amounting to £42,625.

CAMBRIDGE UNIVERSITY.—The British Oil Companies have combined in a scheme for endowing a chemical school at Cambridge, with a donation of 200,000 guineas; Prof. Pope will probably be at the head of the school.

**Engineers Object to Female Labour.**—The Burnley and District Allied Engineering Trades have decided that there shall be no female labour in local engineering shops. Two electrical engineering firms, which employed 30 women, had asked to be allowed to retain this female labour, but the men have refused permission, and have fixed May 24th as the date when all female labour must be withdrawn. The men state that they are proceeding on the lines of the Government guarantee, and they add that there are about 200 engineers idle in the district. Females were not employed before the war.—*Manchester Guardian.*

**Committee on Miners' Lamps.**—The Home Secretary has appointed a Committee to inquire and report what improvements are possible in miners' lamps as regards safety and illumination, and what alterations are desirable in the present methods of testing and approving such lamps for the purposes of Section 33 of the Coal Mines Act, 1911. The members of the Committee are:—Mr. W. Walker, Acting Chief Inspector of Mines (chairman); Prof. F. E. Armstrong, Mr. T. G. Davies (H.M. Inspector of Mines), Mr. Vernon Hartshorn, Mr. G. A. Mitcheson, Mr. S. Roebuck, Mr. J. Wallwork, and Dr. R. V. Wheeler, of Eskmeals. The Secretary of the Committee is Mr. K. G. Fudge, Home Office, Whitehall, S.W. 1.

**James Watt Centenary.**—At a large public meeting in Birmingham, on May 8th, attended by representatives of all the leading engineering societies and scientific institutions, a provisional scheme for the celebration of the James Watt centenary was adopted. No permanent memorial has yet been erected to the inventor of the steam engine. The scheme provides for the endowment of a Chair of Engineering at Birmingham University and the erection of a Memorial Hall and Museum.

The South Kensington Science Museum will hold a Watt Commemorative Exhibition in London.

**Electrical War Inventions for Sale.**—*The Times* states that the Electrical Section of the Disposal Board is about to place on the market a number of interesting articles little known outside naval and military circles.

The daylight signalling lamp, which was invented to replace the heliograph—an article dependent for its effectiveness on sunlight—is one example. Several hundreds of these lamps are for disposal. The apparatus consists of a cylindrical lamp resembling in shape a motor-car side-light or bicycle lamp equipped with a powerful reflector, strong 12-volt dry battery, and a Morse tapper, the whole enclosed in a teak wood box and carried by strong leather straps.

There is also the electric mine exploder, a delicate relay. Sound waves produced by the propeller of an approaching submarine actuate a diaphragm, which operates the relay and causes the mine to explode. Some two to three thousand of these await disposal. Their adaptability to peace-time purposes is a matter left to the enterprising manufacturer.

Specimens of the above apparatus may be seen at the offices of the Board, Room 61, Caxton House, Westminster, S.W. 1."

**The Electricity (Supply) Bill.**—On Wednesday the Bill passed the second reading in the House of Commons without a division.

The Controller of the Miscellaneous Stores Section of the Disposal Board, Caxton House, wants suggestions for the adaptation of heavy guns to industrial uses, as well as the utilisation of cordite, fuses, cartridge cases, mica coated with shellac, and a mixture of alum and soda used for water softening.

**Fatality.**—While playing on the steep railway embankment adjoining the golf club near North Ealing Station, on Sunday last, an eight-year-old boy started to run down the slope. Unable to stop himself, he fell over the wires at the bottom and on to the live rail. Owing to a curve in the line, the driver of an electric train was unable to see what had happened, and his train dragged the boy several yards before he was able to pull up. The boy was dead when lifted from the rails.

**Appointments Vacant.**—Electrical engineer (£500) for the Dartford U.D.C.; head of the Physics and Electrical Engineering Department (£400, rising to £600) for the Borough Polytechnic Institute; head of Electrical Engineering Department (£350) for the Brighton Municipal Technical College; engineer and manager (£350) for the Leek U.D.C. electricity works. See our advertisements pages to-day.

**Inquiries.**—A correspondent wishes to get into touch with a maker of tumbler switches, with the cover and knob made of non-metallic material that will stand a hot damp atmosphere.

Makers of miniature 250-volt, 2-amp., and 110-volt, 4-amp. switches, for use on small motors, and makers of bowls of native alabaster, are asked for.

**Delayed Training Facilities.**—The Durham County War Pensions Committee reports that as regards the proposed training classes in electricity, the situation is the same as last quarter. The commencement of the class is still being delayed owing to the fact that the Local Technical Advisory Committee set up by the Ministry of Labour has not yet approved of the appointment of the instructor (who was appointed in September last), although the Pensions Committee has called attention to the matter on several occasions. This scheme was submitted over 12 months ago, and was approved by the Minister of Pensions. The prolonged delay in the commencement of this class is much to be regretted.

Last month *The Times* quoted the Surrey War Pensions Committee as stating that for a class for electrical work about to be established there were more candidates than it could find room for; much more could be done for the disabled men if the War Office and the Office of Works would help instead of hindering the work. At Guildford the Committee obtained the use of a schoolroom for a class in watch and clock repairing; the Ministry of Pensions approved the scheme, and referred it to the Office of Works to equip the premises; but it took three months to get the electric light installed and the necessary benches provided, and all that time the men were waiting for training. The Committee now had 90 men waiting for training.

**B.T.H. Tungsten Patents.**—In the Court of Appeal, before the Master of the Rolls and Lords Justices Warrington and Duke, on Monday and Tuesday, an appeal was heard by the British Thomson-Houston Co., Ltd., from the judgment of Mr. Justice Sargant, in the Chancery Division, dismissing their application for leave to amend a claim in their specification in Letters Patent relating to an invention regarding a process for the treatment of metallic tungsten and for the manufacture of electric filament lamps therefrom. The case was proceeding when we went to press.

**Wireless in the Air Service.**—In a "Synopsis of British Air Effort during the War," issued recently as a Parliamentary paper (Cmd. 100), and abstracted in the *Times*, some idea is given of the remarkable progress and war record of this branch of the service. With regard to wireless, it is said that only one of the machines which left with the original Expeditionary Force was fitted with apparatus, which was not employed until some stable condition was reached on the Aisne, when work in conjunction with the artillery was started. From this time onwards wireless grew very rapidly, and every battery was gradually equipped with a wireless receiving station; at the end of 1916 there were about 2,000 Air Service wireless operators and mechanics, and by the end of 1917 this number had increased to approximately 3,760. The earliest experiments in wireless telegraphy were carried out between Farnborough and Brooklands, but it was not till 1917 that an efficient set was designed and demonstrated in the air. About this time night bombing machines in France were fitted with C.W. transmitters, with a range of about 75 miles, and proved of great service in reporting suitable targets. At the present time there are about 80 C.W. wireless stations maintained by the R.A.F. in France alone. There are also several hundred battery stations. To meet the demands for trained officers and operators, a training school was started in 1916, with about 30 officer pupils and 500 other ranks. This school has now 152 officers and 2,400 other ranks under instruction. The wireless branch now consists of approximately 520 officers and 6,200 other ranks.

**The Electrical Stimulation of Rainfall.**—Judging from the following extract from the *Sydney Daily Telegraph*, the artificial production of rainfall in Australia has fallen into disrepute:—

A cable published in yesterday's issue informed us that "the Meteorological Office experts discredit the report that an Australian department is able to 'materially stimulate the rainfall by scientific means.' One official declares that the statement must be mis-reported, as such claims have hitherto been made only by humbugs." Such information as has been made available entirely supports the British experts' assumption of a mis-report. No Australian department is known to have supported these wonderful rain-making claims. On the contrary, the Federal department's own officer reported against them. Furthermore, when Mr. Balsillie made overtures to the Government of New South Wales the latter appointed a board of inquiry, including a number of the best-known scientific men, who reported unanimously discrediting the claims, which were not further considered by this State. Mr. Watt, however, publicly expressed his contempt for expert views; and some thousands of pounds have accordingly been paid away in connection with the matter. It is high time the Federal Government gave some assurance that a stop had been put to this inexcusable waste of public money, which is bringing world-wide discredit on Australian common sense.

**Wireless and the Solar Eclipse.**—In connection with the forthcoming solar eclipse on May 29th, 1919, invisible at Greenwich, the British Association Committee for Radio-telegraphic Investigation (of which Sir Oliver Lodge is the chairman) has arranged for the carrying out of experiments on the effect of the eclipse on wireless signals transmitted across the zone.

The umbra intersects the earth's surface in an approximate circle of diameter about 234 km. (126 sea miles), and it moves at the slowest at a speed of about 0.57 km. (0.31 sea mile) per second. Between 11.30 and 12 noon G.M.T. it travels across Bolivia and Brazil, and crosses the Atlantic close to the equator between 12 noon and 14.20. It then crosses the African continent from the French Congo to Mozambique. During the eclipse various wireless telegraph stations will emit signals consisting of letters of the alphabet changed according to a definite plan at the end of each minute; the programme of letters is so arranged that no two come together in the same order more than once. They will be accurately timed at selected receiving stations. By this arrangement the transmitting stations are relieved of the responsibility of timing the signals accurately, and the receiving operators have nothing to do but write down each letter as they receive it and the number denoting its strength. On the day before the eclipse the stations will send practice signals for a short time near noon G.M.T. The British Admiralty stations at Ascension and the Azores will send continuously during the transit of the umbra across the Atlantic Ocean. Observing stations north of the equator will be asked to listen to Ascension for at least an hour about the time when the umbra passes between themselves and Ascension. Similarly observers south of the equator will be asked to listen to the Azores. Certain selected stations north of the equator will be asked to listen to the Azores, so as to afford check observations upon variations that may be observed in signals passing across the central line of the eclipse, and similarly selected stations south of the central line will be asked to listen to Ascension. The American station at Annapolis will also transmit a programme during a portion of the period of the eclipse, and it is hoped that arrangements may be made for special experiments between a few pairs of stations, such as Darien and the Falkland Islands, and an Egyptian station and a South African station.

The main portion of the experiment hinges upon Ascension. The umbral cone passes from west to east, and may be expected to affect in succession the strength in which signals are received at such stations as Demerara, Jamaica, the stations on the cost of the United States and Canada, stations in Ireland, England, France, Italy, in the Mediterranean and Egypt.

The British Admiralty has provided many of the receiving stations both on land and sea, and other receiving stations are being put to work by the American, French, and Italian Governments, by the British Army and Air Force, and also by the Marconi Co. in several parts of the globe. Anyone desirous of obtaining further information should communicate with Dr. W. Eccles, Hon. Secretary of the Committee, City and Guilds Technical College, Leonard Street, London, E.C. 2.

**Piezo Electricity.**—Investigations made recently by Mr. A. McL. Nicolson, in America, have resulted in applying the principles of piezo electricity in a number of ingenious ways to transmit sound vibrations. The possibilities, however, have perhaps only been dimly viewed. Mr. Nicolson built up crystal cells of greatly improved efficiency. Cells weighing but a few ounces were designed which produced hundreds of volts, the wattage, of course, being very low. Rochelle salt crystals were found to be the best for the purpose. One demonstration which is suggestive of other useful applications of piezo cells was to attach to a cell a phonograph needle, mounting the cell on a phonograph in place of the regulation reproducer. The terminals of the cell were then connected with telephone receivers through many miles of wire. As the phonograph was started and the needle placed in contact with the revolving record no sound was heard in the immediate neighbourhood of the phonograph, but miles away in the connected receivers the voice was heard as through an open window across the street.

**Coal Output.**—In 1918, according to a Home Office return, the output of coal in the United Kingdom, which fell from 287,411,869 tons in 1913 to 248,473,119 tons in 1917, decreased still further to 227,714,579 tons, a decline of 20,758,540 tons in comparison with 1917, and of 59,697,290 tons when compared with 1913. The average output per person employed underground fell from 325 tons in 1913 to 294 tons in 1918, and the average output per person employed under and above ground from 262 tons to 232 tons.

**Colloidal Fuel.**—Under the direction of the Submarine Defence Association, a considerable amount of work has been done during the war on the problem of combining coal with petroleum fuel oils. It is now possible to combine in a stable liquid fuel about 45 per cent. oil, 20 per cent. tar, and 35 per cent. pulverised coal, thereby replacing over one-half of the oil, securing equal or greater heat values per barrel, and saving considerable cost.—*Electrical World.*

## OUR PERSONAL COLUMN.

*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*

**Central Station and Tramway Officials.**—Accrington T.C. has deferred for three months the recommendation of the Electricity Committee to increase the salary of Mr. A. W. CLEGG, electrical engineer, by £100.

Mr. S. C. TRANTER, at present relief charge engineer in the London County Council tramways department, has been appointed charge shift engineer at £250 a year, rising to £300.

The salary of Mr. J. B. HORNER, tramways traffic superintendent to the Wigan Corporation, has been increased from £200 to £250 a year.

The Bradford Tramways Committee has accepted the resignation of Mr. A. F. KELLETT, assistant permanent way engineer, who has been appointed permanent way superintendent to the Sheffield tramways department.

The Canterbury T.C. has, by 11 votes to 5, deleted a recommendation that the salary of the electrical engineer, Mr. BLASCHECK, be increased by £99 a year to £566, in accordance with the scale submitted by the Associated Municipal Electrical Engineers.

Clacton-on-Sea U.D.C. has appointed Mr. G. BROADHURST, of Basingstoke, as the electrical engineer.

Nelson T.C. has decided to increase the salaries of the electrical engineer and the tramways manager by £100.

In our last week's reference to Mr. BELLAMY, the new tramways manager and engineer at St. Helens, there were some inaccuracies. His initials are L. C., *not* W. His four years with the Forces were spent on the Gallipoli Peninsula and on the Somme—not in Rangoon. Previous to his appointment as assistant to the St. Helens Tramways Co. he was the manager of the Rangoon tramways for four years, and before joining the Army he was tramway manager and borough electrical engineer at Ilkeston.

On May 8th a presentation was made to Mr. C. J. ELLIOTT, A.M.I.E.E., by the staff of the Lancashire Electric Power Co., on his leaving to join a distribution company in the south.

**General.**—The Chair of Experimental Philosophy at Oxford, vacated by Professor Clifton at the beginning of the war, has been filled by the appointment of Dr. F. A. LINDEMANN.

Second Lieutenant J. P. MONSON, City of Dundee Fortress Engineers (Electric Lights Company), has been confirmed in his rank. He was gazetted to the corps in October, 1917.

Lieutenant F. W. BOND, Tyne Electrical Engineers, who was a supernumerary officer whilst attached for duty to another corps, has been restored to the establishment of his regiment. Lieutenant Bond was commissioned in 1915 and promoted lieutenant in 1918.

Messrs. R. T. NORTON & Co., consulting engineers, Temple Courts, Temple Row, Birmingham, and J. L. H. COOPER, B.A., A.M.I.E.E., A.M.I.Mech.E., Royal Dock Chambers, Grimsby, consulting engineer, have entered into a provisional working agreement.

Mr. WALTER LEAF, chairman of the St. James' & Pall Mall Electric Light Co., Ltd., and of the London County and Westminster and Parrs Bank, Ltd., is nominated by the Council of the Institute of Bankers for election as president.

Mr. F. C. RAPHAEL, M.I.E.E., has been appointed manager of the cable and wire department of the Edison Swan Electric Co., Ltd. (Ponders End). Soon after the outbreak of the war he joined the R.N. Anti-Aircraft Corps, but in February, 1916, obtained a transfer and a commission to the London Electrical Engineers R.E. (T.). On his return from France last August, Mr. Raphael was appointed an assistant inspector under the C.I.R.E.S., and was in charge of cable inspection up to the date of his demobilisation. He will be remembered as being successively editor of *The Electrician* and *Electrical Engineering*; previously he had been on the staff of cable manufacturing companies in this country and abroad.

Capt. H. G. WHITE, R.E., who has now been demobilised, has severed his pre-war connection with Messrs. Gent & Co., Ltd., Leicester, and rejoined the staff of the Sterling Telephone & Electric Co., Ltd., with whom he was previously associated for many years. Capt. White was employed during the war as instructor at the Anti-Aircraft, Searchlight and Sound Locator School, and has received a special mention for valuable services rendered in connection with search light operations.

Captain F. B. C. SUTHERY, A.M.I.E.E., Tyne Electrical Engineers, has been restored to the establishment of the Territorial Force. Capt. Suthery was employed as a captain of the Royal Marines for some time, and has been connected with the corps since the beginning of the war.

Lieutenant and Acting-Captain W. F. BALDERSTON, Renfrew Fortress (Electric Lights) Engineers, has vacated the adjutancy of the 62nd Divisional Royal Engineers, and relinquished the acting rank of captain on ceasing to be employed.

**Roll of Honour.**—Lord Onslow, chairman of the North Staffordshire Railway Co., recently presented the Military Medal to Sergt. GEORGE BOSLEY, electric light engineman, who served in France with the R.E. (Signals). His lordship stated that the Earl of Dartmouth had informed him that the work of the men from the electrical department of the North Stafford Railway on the signals at the front was most commendable.

Private C. L. FOREST, M.G.C., is now presumed killed after being missing since March last year. He was formerly an employé of Messrs. Dick, Kerr & Co., Ltd.

**Obituary.**—MR. W. E. BLAKE.—We regret to record the death at the age of 55 years, of Mr. W. E. Blake, superintendent of the line of the Underground Electric Railways Co. It appears that while engaged directing certain operations on the railway he slipped and injured his leg. Septic poisoning subsequently necessitated amputation of the leg. He died after an operation on May 8th at St. George's Hospital.

SIR J. H. A. MACDONALD.—We regret to record the death, at the age of 83 years, of the Rt. Hon. Sir John H. A. MacDonald, P.C., G.C.B., LL.D., F.R.S., F.R.S.E., M.I.E.E., late Lord Justice Clerk of Scotland. The funeral took place at Edinburgh on the 13th inst. Sir John became an Associate of the Institution of Electrical Engineers in 1882, and a Member in 1886. He was an inventor of electrical appliances, military telegraphs, &c., and a writer on various automobile, electrical, and general matters.

**Will.**—The late Mr. H. P. J. NEGRETTI, of Negretti and Zambra, left £99,520 gross.

## NEW COMPANIES REGISTERED.

**Craymer Unloaders, Ltd.** (154,749.)—Private company. Registered May 1st. Capital, £300 in £1 shares. To acquire Patent No. 116,416 of 1918, for improvements in an unloading or discharging device, in the name of H. J. Craymer, and to carry on the business of mechanical and electrical engineers, &c. The subscribers (each with one share) are:—H. J. Craymer, 5, Clifton Square, Peckham, S.E., engineer; R. F. Smith, 8, Hanover Street, Peckham, S.E., ironmonger. Registered office: 97, High Street, Peckham, S.E.

**Henry J. Monson, Ltd.** (154,720).—Private company. Registered April 30th. Capital, £7,000 in £1 shares. To take over the business of a radiologist and electric medical and therapeutic operator carried on by H. J. Monson at 26, Manchester Street, W. The subscribers (each with one share) are:—H. Baines and T. Baines, both solicitors, of 8, New Burlington Street, W.1. The first directors are to be appointed by the subscribers. Registered office: 26, Manchester Street, W.

**H. T. Boothroyd, Port Glasgow, Ltd.** (10,355.)—Private company. Registered in Edinburgh April 26th. Capital, £10,000 in £1 shares. To take over that part of the business of H. T. Boothroyd, Ltd., of Akenside Street, Bootle, Lancs., electrical engineers, which comprise the general electrical contracting business carried on in Scotland and the installing of electrical equipment on ships. The subscribers (each with one ordinary share) are:—H. Thomas Boothroyd, Woodthorpe, Great Crosby, Liverpool, electrical engineer; W. H. Thomson, 67, Worcester Road, Bootle, Liverpool, electrical engineer. First directors: H. Thomas Boothroyd and J. Whitehead. Registered office: Bank Buildings, 24, Princes Street, Port Glasgow.

**Eural Patents, Ltd.** (154,750.)—Private company. Registered May 1st. Capital, £1,000 in £1 shares. Inventors and exporters of patents, and to enter into agreements with Sir Evelyn de la Rue and J. Lindsay Scott for certain inventions relating to pocket lighters, to electrical contact-makers, and to name indexes for telephones. The subscribers (each with one share) are:—Sir A. de la Rue, Bart., Lockleys, Welwyn, Herts.; J. Lindsay Scott, 9, Harrington Court, S.W.7. First directors: Sir E. de la Rue, Bart., J. Lindsay Scott, and Miss C. Hume, 14, Somers Place, W. Registered office: 19-20, Premier House, Dover Street, W.1.

**R. F. Fuggle, Ltd.** (154,512).—Private company. Registered April 19th. Capital, £4,000 in £1 shares. To take over the business carried on at Edgware and Elstree as F. F. Fuggle, and to carry on the business of manufacturers, repairers, and sellers of electric, steam, gas, oil, and other engines for motor vehicles, aircraft, boats, ships, railways and tramways, &c. The subscribers (each with one share) are:—R. E. F. Sneath, Gloucester Lodge, Hendon, business manager; E. H. Pool, Hazelmere, Montgomery Road, Edgware, works manager. First directors: R. F. Fuggle and R. E. F. Sneath. Solicitor: E. C. Harrison, 1, New Court, Lincoln's Inn, W.C.

**Trafford Park Traders' Association, Ltd.** (154,689.)—Registered April 29th, as a company limited by guarantee, without share capital, with 200 members, each liable for £1 in the event of winding up, to promote and protect the trade, commercial, or other interests of owners, lessees, and occupiers of land or buildings in Trafford Park, Lancs., to promote the consideration of all questions affecting the interests of such persons, or of any persons carrying on any trade or occupation in Trafford Park, to promote or oppose legislation, to collect and circulate information, to promote, support, oppose, or defend legal or other proceedings which may affect such interests, or relating to facilities afforded, or rates or conditions imposed by any railway, tramway, canal, or shipping company, or by any carriers or warehousemen, or by any lighting, traction, telephone, dock, harbour, or other public utility corporation or undertaking, &c. The first members of the council are:—J. E. Davenport, 15, Derby Road, Urmston, near Manchester, traffic manager; W. Kenyon, Westwood, Sale, Ches., secretary of Royce, Ltd.; E. A. Pochin, Rosthwaite, Lightwood Road, Buxton, engineer employer; F. J. Warren, 10, Clifton Road, Chorlton-cum-Hardy, Manchester, secretary; W. T. Glover & Co., Ltd.; Howard Asphalte & Troughing Co., Ltd., Trafford Park Power & Light Supply Co.; and Ashover Mines, Ltd.; J. O. Cheetham, Ivanhoe, Richmond Road, Altrincham, secretary, Lancashire Dynamo & Motor Co., Ltd.; R. Gravelley, Rowanhurst, Ashton-on-Mersey, director of Illingworth, Ingham & Co., Ltd., sawmill owners, Leeds; J. Mastin, Glossop Road, Marple Bridge, near Stockport, buyer for Co-operative Wholesale Society. The memorandum of association is signed also by A. Chandler, of the British Westinghouse Electrical & Manufacturing Co., Ltd. Hon. Secretary: W. Kenyon. Solicitors: Claremont, Haynes & Co., Vernon House, Bloomsbury Square, W.C.

**Penrose Lifts, Ltd.** (154,755.)—Private company. Registered May 1st. Capital, £15,000 in £1 shares. To acquire that portion of the business of A. W. Penrose & Co., Ltd., relating to the manufacture of electric lifts and cranes, &c. The subscribers (each with one share) are:—M. Owen, 2, Hilton Avenue, North Finchley, 1; F. W. Tompson, The Towers, Limpsfield, Surrey, brewer; F. E. Searles, Lindley, Godstone Place, Godstone, Surrey, engineer; F. J. Tompson, The Bowers, Limpsfield, Surrey, engineer. Directors: M. Owen, F. E. Searles, F. J. Tompson and F. W. Tompson, also director of Frank Jones Brewing Co., Ltd., Russell's Gravesend Brewery, Ltd., Writtle Brewery Co., Ltd., British Photographic Industries, Ltd., Houghtons, Ltd., W. Butcher & Sons, Ltd., &c. Office: 239, Southwark Bridge Road, S.E. 1.

**Wellman Smithowen Engineering Corporation, Ltd.** (154,585).—Private company. Registered April 24th. Capital, £100,000 in £1 shares. To take over and amalgamate all or part of the businesses of Wellman, Seaver & Head, Ltd., the James Smith Hoisting Machinery Co., Ltd., and Rubery Owen & Co., and to carry on the business of manufacturers of and dealers in engineering machinery, machine tools and instruments, electrical engineers, &c. The subscribers (each with one share) are:—A. E. Owen, Koyama, Sutton Coldfield, manufacturer; F. I. Sanderson, King's House, Kingsway, W.C. 2, managing director of Wellman, Seaver & Head, Ltd. First directors: A. E. Owen (permanent), F. I. Sanderson (commercial manager), T. Smith (managing director), and F. G. Smith (chief engineer). Registered office: King's House, Kingsway, W.C.

**A. C. Cutting & Welding Co., Ltd.** (154,941).—Private company. Registered May 8th. Capital, £20,000 in £1 shares. To enter into an agreement with J. F. Alvord, A. D. T. Libby, C. W. Curtiss, Sarah E. Curtiss, and C. Marion Smith, manufacturers of and dealers in cutting and welding devices. The subscribers (each with one share) are:—C. E. Roraback, 6, City Road, E.C., managing director, American Supplies Co., Ltd.; F. Farquhar, 162, Great Portland Street, W., business manager (electrical). First directors: C. E. Roraback and F. Farquhar. Solicitor: W. R. J. Hickman, 11, Ironmonger Lane, E.C.

**Bolton Chemical Plant Manufacturing Co., Ltd.** (154,944).—Private company. Registered May 8th. Capital, £5,000 in £1 shares. Manufacturers of chemical plant, lead workers and burners, plumbers, manufacturers of electrical accumulators and apparatus, &c. First directors:—J. Chadwick, 12, Nuttal Terrace, Bolton; J. N. Chadwick, 39, Sutherland Road, Bolton; A. Parkinson, 13, Wellington Terrace, Morecambe; T. Willetts, 114, Tonge Moor Road, Bolton. Solicitors: Balshaws, 22, Acresfield, Bolton.

**British Glass Blowers, Ltd.** (154,945.)—Private company. Registered May 8th. Capital, £2,000 in £1 shares. To acquire certain premises at Tollington Park, N., to construct and carry on glass works there, &c. The subscribers (each with one share) are:—H. W. Sullivan and J. Joseph, both electrical engineers, of Winchester House, E.C. 2. First directors: H. W. Sullivan, J. Joseph, and E. G. Foley. Solicitor: F. P. Landon, 53, New Broad Street, E.C.

**Electrical Utilities, Ltd.** (154,805.)—Private company. Registered May 2nd. Capital, £5,300 in 5,000 cum. part. pref. shares of £1 and 6,000 ord. shares of 1s. Manufacturers of and dealers in electrical devices, appliances and materials, &c. The subscribers (each with one ord. share) are:—Capt. E. A. Godson, The Court, Tenbury, Worcs.; E. Schattner, 117, Corringham Road, Golders Green, electrical engineer. First directors: E. Schattner (chairman), P. H. S. Gibbs (managing director), and E. A. Godson. So long as the said E. Schattner remains a director of the Electrical Apparatus Co. (1913), Ltd., the company shall not manufacture, sell, purchase, or deal in any electrical motor control gear or electricity meters, or any inventions or patents relating thereto. Secretary: P. H. F. Gibbs. Registered office: 35, Copthall Avenue, E.C.

**Central Electric (Handsworth), Ltd.** (154,851.)—Private company. Registered May 5th. Capital, £100 in £1 shares. Manufacturers of electric plant and fittings, contractors for electric power, telephones and bells. First directors: H. Bowker, 63, Church Hill Road, Handsworth, electrician; R. A. Hudson, 14, Kingscote Road, Edgbaston, electrician. Registered office: 112, Hamsted Road, Handsworth, Birmingham.

**Ignitions, Ltd.** (154,722.)—Registered April 30th. Capital, £30,000 in 20,000 shares of £1 each and 20,000 shares of 10s. each. To enter into an agreement with the C.C. Sparking Plug Co., Ltd., to acquire and turn to account patents, &c. First directors:—C. L. Simpson, 13, Montagu Place, W., engineer; and T. Charlton, 167, Inderwick Road, N., financial agent. Registered office: 10, Throgmorton Avenue, E.C.

**Gwalia, Ltd.** (154,842.)—Registered May 3rd. Capital £1,000 in £1 shares. To carry on the business of an electric light and power company, electricians, electrical engineers, &c. First directors:—K. M. Clark, Lyde House, Sion Hill, Bath, chairman of Unity Investment Trust Co.; J. W. Cassells, The Lodge, Orford, Suffolk, private secretary, director of above trust; and H. J. Jack, Maenan Manor, Llanrwst, director of said trust. Registered office: 4, Broad Street Place, E.C. 2.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Corona Lamp Works, Ltd.**—Particulars of £30,000 first prior lien debs. created March 31st, 1919, of which £22,000 are now issued, charged on the company's undertaking and property, present and future, including uncalled capital, ranking in priority to the prior lien debs. and the ordinary debs. Trustee: G. N. Ogilvie and A. Ogilvie.

**F. A. Jennings, Ltd.**—Particulars of £10,000 debentures, created April 11th, and all issued April 15th, 1919, charged on the company's undertaking and property, present and future, including uncalled capital.

**Robinson & Hands Electrical Co., Ltd.**—Satisfaction in full on March 1st, 1919, (*a*) of mortgage debenture dated 1909, securing £400, and (*b*) of mortgage debentures dated 1910, securing £300.

**Landaulet Co., Ltd,** (formerly Electric Landaulet Co., Ltd.).—R. G. Sidford, of 20, John Street, W.C. 2, ceased to act as receiver or manager on April 16th, 1919.

**Tramways, Light & Power Co., Ltd.**—Second supplemental trust deed dated April 14th, 1919, securing a further £75,000 5 per cent. debenture stock (making a total of £375,000 secured by principal deed of 1914 and two supplemental deeds).

**Durell, Walker & Co., Ltd.**—H. Dennis, of 84, Boundary Road, N.W. 8, ceased to act as receiver or manager on March 26th, 1919. H. M. Gower, 51-2, Chancery Lane, W.C. 2, was appointed receiver or manager on same date.

**Smith & Mortimer, Ltd.**—Particulars of £2,000 debs., created and all issued March 31st, 1919, charged on the company's undertaking and property, present and future, including uncalled capital.

**S. Bornett & Co., Ltd.** (89,565.—Capital £2,000 in £1 shares (1,000 pref. and 1,000 ord.). Return dated April 1st, 1919. 757 pref. and 950 ord. shares taken up; £1 per share called up on 757 pref. and 200 ord.; £957 paid; £750 considered as paid on the remaining ord. Mortgages and charges: Nil.

**Cosmos Engineering Co., Ltd.** (formerly Brazil, Straker and Co., Ltd.).—Satisfaction in full on April 8th, 1919, of charge dated April 13th, 1918, securing £25,000 already advanced, and further advances up to £50,000.

**David Powis & Sons, Ltd.**—Particulars £16,000 debs. created and all issued April 24th, 1919, charged on the company's undertaking and property, present and future, including uncalled capital and unpaid calls.

**Tilling-Stevens, Ltd.**—Supplemental trust deed dated April 15th, 1919, to secure a further £100,000 first mortgage debenture stock ranking *pari passu* with £50,000 issued on the security of the trust deed dated November 11th, 1912.

**A. W. Richardson & Son, Ltd.**—Mortgage on land and premises at Ashton-under-Lyne dated April 9th, 1919, to secure all moneys due or to become due from the company to Manchester & Liverpool District Bank.

**Thompson & Gingell, Ltd.**—Particulars of £2,000 debs., created April 9th, 1919, of which £1,000 were issued on same date. Property charged: The company's undertaking and property, present and future, including uncalled capital. Commission, allowance, or discount, 150 £1 ord. shares for each £100 debs.

**Cosmos Consolidated, Ltd.**—Particulars of £500,000 debs. created February 11th, 1919, of which £6,000 are now issued, charged on the company's undertaking and property, present and future, including uncalled capital.

**White, Jacoby & Co., Ltd.**—Issue on May 1st, 1919, of £120 debs., part of a series already registered.

**Rawlings Bros., Ltd.**—Satisfaction to the extent of £1,550 on December 4th, 1918, of charge dated December 4th, 1918, securing £8,750.

**Dargue, Griffiths & Co., Ltd.**—Satisfaction in full on June 30th, 1918, of charge dated 1909, securing £3,000.

**Wycombe (Borough) Electric Light & Power Co., Ltd.** (53,133).—Capital, £50,000 in £5 shares. Return dated April 15th, 1919. 8,000 shares taken up; £40,000 paid. Mortgages and charges: £40,000.

**Direct Spanish Telegraph Co., Ltd.** (6,732.)—Capital £95,000 in 13,000 ord. and 6,000 pref. shares of £5 each. Return dated April 9th, 1919. 12,831 ord. and 6,000 pref. shares taken up; £94,655 paid. Mortgages and charges: Nil.

**Erskine, Heap & Co., Ltd.** (formerly Eckstein, Heap and Co., Ltd.) (126,262).—Capital, £50,000 in £1 shares. Return dated April 10th, 1919. 30,000 shares taken up; £7,500 paid; £22,500 considered as paid. Mortgages and charges: Nil.

## CITY NOTES.

**Indian Electric Supply and Traction Co., Ltd.**

Mr. J. G. B. Stone presiding at the annual meeting in London, on May 6th, said that they had sold 4,105,126 units, an increase of 112,827. There were increases of 72,395 units for lighting and fans, 85,106 for power, and 11,907 for public lighting, but special contracts were less by 62,856. Lighting and fan units realised about a halfpenny more per unit than for 1917, power a fraction more, and public lighting a fraction less. Practically everything on the expenditure side had increased. The prospects for gradual development of the ordinary business and its earning capacity were favourable, but they had also under consideration the question of establishing a bulk supply station for generating power at a sufficiently low cost to secure the power loads of large consumers, mills, &c., and at the same time draw supplies at a very much lower price than it was possible to generate it at in the present station. If they could secure a site within a reasonable distance of Cawnpore, where there would be a permanent and ample supply of condensing water, they would be able to generate at a considerably lower rate, and secure a big power load for which they could not as at present offer a sufficiently attractive rate. They were paying an increase of ¼ per cent. in dividend.

**Metropolitan Electric Tramways, Ltd.**

The revenue for 1918 amounted to £639,021. After deducting all expenses chargeable to revenue, including debenture and loan interest, but without making any provision for future renewals, there is a surplus of £7,664, plus £3,036 brought forward. £10,174 is to be placed to reserve, and £526 carried forward. The traffic receipts were £627,334, an increase of £84,803, which is due in part to the larger number of passengers, and in part to the higher rate of fare intro-

duced in the autumn of 1917. Owing, however, to the enhanced cost of labour and materials, working expenditure, which, exclusive of the payments to the County Councils, amounted to £491,044, shows an increase of £83,886. With a view to enabling the company to meet the continual rise in working costs, and to make the necessary provision for future renewals, a further increase of fare was, with the consent of the County Councils concerned, brought into effect early this year. High cost of fuel and increased labour charges have caused a diminution of the profits of the North Metropolitan Electric Power Supply Co., in which this company holds all the ordinary share capital. No dividend will be paid by the Power Co. on its ordinary shares for the year (as against 10 per cent. paid for 1917). The directors are, therefore, unable to recommend any dividend on the preference shares.

**Urban Electric Supply Co., Ltd.**

The gross profits for 1918 were £63,890, against £67,732 for 1917. After deducting expenses in profit and loss account, and paying interest, debenture stock redemption, and income tax, absorbing £44,452, the available balance, including £4,498 brought forward, is £19,966. There is put to reserve for depreciation £10,000, 2½ per cent. for the year is paid on the preference shares, £6,250, and £3,716 is to be carried forward. The following table shows the load and profits of each of the various undertakings:—

| | Kilowatts. | | Profits. | |
|---|---|---|---|---|
| | 1917. | 1918. | 1917. | 1918. |
| Hawick .. .. .. .. | 3,863 | 3,845 | £5,863 | £4,509 |
| Stamford .. .. .. | 1,720 | 1,756 | 2,208 | 2,287 |
| Weybridge and Walton .. .. | 3,634 | 3,919 | 5,488 | 4,590 |
| Godalming .. .. .. | 1,800 | 1,986 | 2,247 | 2,332 |
| Twickenham and District .. | 9,191 | 10,171 | 15,175 | 14,716 |
| Dartmouth .. .. .. .. | 1,038 | 1,070 | 1,116 | 607 |
| Camborne and Redruth ("A") and Cornwall ("B") | 8,052 | 8,396 | "A" 8,030 "B" 7,294 | "A" 8,609 "B" 7,260 |
| Newton Abbot .. .. .. | 1,337 | 1,602 | 2,723 | 2,932 |
| Grantham .. .. .. .. | 1,983 | 2,070 | 8,705 | 8,074 |
| Glossop .. .. .. .. | 1,423 | 1,434 | 3,370 | 3,470 |
| Berwick .. .. .. .. | 1,138 | 1,161 | 1,006 | 479 |
| Caterham .. .. .. .. | 991 | 1,080 | 1,166 | 1,056 |
| Newbury .. .. .. .. | 1,232 | 1,320 | 3,386 | 905 |
| Totals .. .. .. | 36,902 | 39,503 | £67,717 | £63,766 |

**London and Suburban Traction Co., Ltd.**

The report for 1918 states that the continuance of war conditions has intensified the difficulties of the tramway, omnibus, and electric supply undertakings of the company. In all cases operating expenses have further increased as a result of the additional war wages awarded and the higher cost of fuel and other materials. Shortage of labour and the difficulty of obtaining material have caused a reduction of the number of tramcars in service. The tramways and motor omnibuses all show an expansion of gross revenue due partly to increased traffic and partly to increased fares, but the additional receipts have not been more than sufficient to balance the increased cost of operation. In consequence of the decrease in the dividends receivable from the subsidiary companies, due in part to the decrease in profits of the North Metropolitan Electric Power Supply Co., whose ordinary shares are all held by the Metropolitan Electric Tramways, Ltd., and in part to the Tramways (M.E.T.) Omnibus Co., Ltd., finding it necessary to make provision for the early renewal of its fleet, the directors are unable to recommend the payment this year of any dividend upon the preference shares of the company. The gross revenue for the year amounted to £46,294, as compared with £81,519 for 1917. After deducting all expenses chargeable to revenue, including debenture and loan interest, and providing for the sinking fund charges upon the 5 per cent. debenture stock, there remains a balance of £3,458, making, with £3,635 brought forward, a total of £7,092, which is to be carried forward. During 1918 £13,237 five per cent. debenture stock was purchased and cancelled.

The scheme referred to in the previous report for the reorganisation of the capital of the London United Tramways, Ltd., has received the sanction of the Court, and is now being carried into effect. By its Act of 1918, the London United Co. has secured an extension of the tenure of its tramways in Middlesex and Surrey until 1950, and will also have power at the expiration of six months after the termination of the war to make substantial increases in its existing statutory fares. In the meanwhile it has put into operation increases of fares which have recently been authorised by the Board of Trade under the Statutory Undertakings (Temporary Increase of Charges) Act, 1918. The L.U.T. Act above referred to imposes an obligation upon the L.U. Co. to provide, for the purpose of renewals, the sum of £400,000, towards which the purchase price payable by the L.C.C. for the Hammersmith tramways, amounting to £235,000, will be available.

**British Westinghouse Electric and Manufacturing Co., Ltd.**

The profit for 1918, including £51,234 brought forward, is £198,152. Out of this £42,315 has been put to special depreciation of plant, machinery, &c. A dividend of 8 per cent., less tax, on the cumulative preference shares absorbs £78,090, and £77,747 is to be carried forward. Mr. Lincoln Chandler has resigned the position of managing director, but retains his seat on the board. Captain R. S. Hilton has been appointed managing director. In accordance with the undertaking given by the Metropolitan Carriage, Wagon & Finance Co., Ltd., at the meeting last November, £1,000,000 of ordinary shares of the company have been applied for, and they were allotted for cash at par on April 14th. The attention of preference shareholders has already been drawn by circular to their option to convert any or all of their preference shares into ordinary shares within two years from April 14th, 1919.

Meeting, to-day, at Connaught Rooms, London, W.C.

The profit shown in the previous report was £177,859, including £89,735 brought forward. The amount then put to depreciation was £48,000 and £10,000 was put to reserve for employers' liability. The dividend at 7½ per cent. on the preference shares absorbed £68,625.

**London United Tramways, Ltd.**

The operation of the undertaking during 1918 resulted in gross receipts of £362,427, an increase of £7,954, but owing to continued advances in cost of material and labour the expenses increased by £81,970 to £373,831, showing an adverse balance of £11,405. After charging debenture and loan interest for the year, and bringing in the deficiency of the two preceding years, the total deficiency to be carried forward to 1919 was £94,050. The scheme for the reorganisation of the capital has been sanctioned by the Court. It provides (*inter alia*) for the cancellation of the arrears of interest on the issued first mortgage debenture stock for the year 1917, and for the reduction of such stock by 48 per cent. as from January 1st, 1918, so the whole of the deficiency of £94,050 mentioned above, is extinguished. The arrears of dividend on the preference shares to December, 1918, which amounted to £621,875, and the dividend accrued to April 8th, 1919, are also cancelled. The Company's Act of 1918 which has received the Royal Assent authorises an extension of the company's tenure of the tramways in Middlesex and Surrey until 1950, and empowers the company, at the expiration of six months from the termination of the war, to raise its fares to a maximum of 1d. per mile for ordinary passengers, and 1d. for three miles for workmen. Pending the date on which the powers to increase the fares under this Act take effect, the company has put into operation increases of fares authorised by the Board of Trade under the Statutory Undertakings (Temporary Increase of Charges) Act, 1918. Viscount Knutsford and Capt. F. V. Schuster have resigned their seats on the board, and Sir Lewis Coward, K.C., Mr. G. Balfour, M.P., and Mr. C. G. Tegetmeier, have been appointed directors, the first two of these representing the interests of the first mortgage debenture stockholders. The board as now constituted is as provided by the scheme for the reorganisation of capital.

**Swiss Companies.**

The accounts of the *Motor, A.G. fur Angewandte Elektrizitat, of Baden*, show net profits of £90,000 for 1918, as contrasted with £91,000 in the preceding year. It is proposed to pay a dividend of 7 per cent., as in 1917.

The *A.G. Columbus fur Elektrische Unternehmungen, of Glarus*, which is an investment company specially interested in the Stats-Argentine Electricity Co., of Buenos Ayres, reports net profits of £72,000 for 1917-18. The dividends on the "B" shares is at the rate of 7 per cent., and that on the "A" shares 5½ per cent.

The report of the *Aluminium Industrie A.G., of Neuhausen*, states that notwithstanding increased difficulties in obtaining supplies of raw materials in 1918, it was possible to keep the works in operation until October in that year. A stoppage took place in the final quarter owing to the political events in Germany and Austria. The directors hoped in the near future to regain possession of the installations in the South of France which had been under sequestration since 1914, and to receive full payment for their having been utilised for years. The political events, and the lack of willing workers had led to restrictions in working. The accounts record net profits of £501,000, as compared with £792,000 in 1917, and the dividend is at the rate of 20 per cent., being the same as in the previous year, when, however, profits of £280,000 were also transferred to the fund for fully paying up the partly-paid shares.

**French Companies.**

*The Société Francaise des Electrodes* reports net profits of £41,000 for 1917-18. A dividend at the rate of £1 8s. per share has been declared on the old capital and 18s. 9d. on the new shares.

*The Société Gramme* proposes to pay a dividend of £1 18s. 5d. for 1917-18, as compared with £1 16s. in the preceding year. The share capital is now to be increased from £92,000 to £140,000.

The directors of the *Société d'Electro-Chimie, of Gifre*, recommends the payment for 1917-18 of a dividend of £2 1s. 7d. per share on the old capital and £1 0s. 9d. on the new shares. A rate of £2 16s. per share was declared in 1916-17 on a lesser amount of share capital.

*The Société Centrale pour l'Industrie Electrique* intends to distribute 5 per cent., or £1 per share, for 1918, this comparing with no dividend in 1917. It is stated that the installations of the company's branch at Baku have not suffered any damage from recent events and continue in operation.

**German Companies.**

The directors of *Felten & Guilleaume Carlswerk A.G., of Cologne and Mulheim*, recommend the payment of a dividend of 10 per cent. for 1918, as contrasted with 15 per cent. in the previous year.

The accounts of the *Deutsche Kabelwerke A.G., of Berlin-Lichtenberg*, show gross profits of £128,000 for 1918, as compared with £101,000 in the preceding year, and net profits of £44,000 and £45,000 in the two years respectively. It is pro-

posed to pay a dividend of 10 per cent., being the same rate as in 1917.

The accounts of the *Faradit Isolier Rohr Werke Max Haas A.G., of Reichenhain, Chemnitz*, after placing £8,000 to depreciation in 1918, as compared with £16,000 in 1917, indicate net profits of £45,000 and £97,000 in the two years respectively. The directors recommend a dividend of 30 per cent., as in the preceding year.

*The Lloyd Dynamo Werke A.G., of Bremen*, after allocating £6,000 to depreciation account in 1918, as against £11,000 in 1917, reports net profits of £10,000, as contrasted with £7,000 in the previous year. The directors propose the payment of a dividend of 7 per cent. on the share capital of £125,000, being the same rate as in 1917.

*The Elektro Salpeter Werke A.G., of Berlin*, which is associated with the A.E.G. and the Griesheim-Elektron Chemical Works, and which was affected by a serious explosion in 1917, reports an increase in the debit balance of £10,000 in the latter year to £70,000 in 1918 on a share capital of £150,000.

*The Elektrochemische Werke G.m.b.H., of Berlin*, whose share capital of £350,000 is held by the Zurich Bank for Electrical Undertakings, reports net profits of £96,000 for 1918, after writing off £45,000 for depreciation of war plant, as compared with profits of £109,000 in the preceding year. It is proposed to pay a dividend of 12 per cent., as against 15 per cent. in 1917.

*The Elektro-Nitrum A.G., of Berlin*, which was formed in 1915 by the A.E.G. and the Griesheim-Elektron Chemical Works, reports gross profits of £131,000 in 1918, as contrasted with £104,000 in the previous year. Interest charges, a large loss on exchange, and the allocation of £64,000 to depreciation, as compared with £71,000 in 1917, bring the final result to net profits of £7,000, which reduce the existing debit balance to £20,000 on share capital of £150,000.

The report of the *Hochfrequenz Maschinen A.G. fur Drahtlose Telegraphie, of Berlin*, states that the company's transmarine wireless traffic in 1918 again answered the purpose. The net profits amounted to £29,400, as against £29,500 in 1917, and the "A" shares are to receive a dividend and bonus of 21½ per cent., and the "B" shares 49.6 per cent. The Eilvese and Tuckerton stations are entered as being of the value of £92,000 and £90,000 respectively, as in the previous year.

The report of the *Ges. fur Elektrische Hoch und Untergrundbahnen, of Berlin*, states that the number of passengers carried increased from 108,400,000 in 1917 to 113,000,000 last year, and overcrowding continued to prevail. The average wages, which previous to the war amounted to 52 pfennigs (6.11d.) per hour, rose to 1.20 marks (1s. 2¼d.) in 1918, and was now (April, 1919) about 2.15 marks (2s. 1½d.) per hour. A similar movement had taken place in the prices for coal. It was possible, however, to obtain compensating advantages through the two increases in passenger fares, which were introduced in April, 1918, and in January, 1919. The receipts advanced from £735,000 in 1917 to £991,000 last year, and the net profits from £139,000 to £202,000 in the two years respectively. The dividend on the ordinary capital of £2,625,000 is at the rate of 5½ per cent., this contrasting with 3½ per cent. in 1917.

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**River Plate Electricity Co., Ltd.**—The net revenue, after providing for administration expenses, bad debts, and depreciations, amounts to £26,901; £25,961 was brought forward, making £52,862. After paying the 5 per cent. debenture interest, and 7 per cent. on the ordinary stock, £4,000 is put to income tax reserve and £17,612 is to be carried forward. As regards current supplied in bulk to customers under long-date contracts the situation was met by an increase in charge corresponding to the enhanced market price of fuel, and it was only this fact, combined with the utmost economy, which prevented an actual serious loss upon the sale of current to private consumers at La Plata and Ensenada. The earnings do not justify the dividend on the ordinary stock, but in view of the better outlook the board think they may properly use some part of the profits from former years to maintain the dividend. Default has continued on the 5 per cent. obligations of the German Trans-Oceanic Electric Co., but it is assumed that the Peace Treaty shortly to be signed will regularise relations with enemy countries, and, it is hoped, permit of a settlement of the large outstanding indebtedness due to this company. Interest has been paid on the £66,667 5 per cent. debentures of the Tucuman Tramways, Light & Power Co., and a dividend has also been paid on the company's shareholding in the Argentine Electricity Co.—*Financial Times.*

**Johnson & Phillips, Ltd.**—The profit on trading accounts, &c., for the year ended December, 1918, after providing for bad and doubtful debts, and charging to revenue upwards of £13,000 for maintenance of buildings, plant, &c., amounts to £80,491, plus £25,815 brought forward, less dividend paid in April, 1918, £12,250, making £94,056. This is dealt with as follows: Directors' and other fees, £1,679; debenture interest, £4,540; debenture sinking fund reserve, £8,355; second debenture interest, £2,500; depreciation on machinery, plant, &c., £14,423; interest on loans, £1,100; reserve account, £10,000; income tax and excess profits duty, £10,127; written off patents, £2,500; dividend of 10 per cent. on ordinary shares, £17,500; carried forward, £21,332. The annual meeting was held yesterday.

**Shawinigan Water & Power Co.**—Year 1918. Gross earnings, $3,621,074, an increase of $718,864. Net revenue $1,410,093, an increase of $59,229. Operating costs affected seriously through increased cost of labour and material, insulators, copper coils for generators and many similar items having trebled or quadrupled in price. Output of the carbide factory largest in the history of the company. The growth of the power business has continued, not only due to war conditions, but also to permanent industries. Total KW.-hours generated for the Shawinigan system 1,058,127,769, an increase of 12 per cent. All the remaining power under option from the Laurentide plant will be used within the next two or three years. The next step is the development of the power at Gres Falls, a property owned by this company. This development will have a capacity of about 100,000 H.P., and will take about two years to construct. The directors feel that the present is not a suitable time to proceed with this development. Engineering information is being obtained, and plans are being made which will be available when the proper time arrives to commence this construction work.—*Financial Times.*

**Brush Electrical Engineering Co., Ltd.**—Including £12,700 brought forward, £103,798 is available for 1918, subject to excess profits duty in respect of 1917 and 1918. The change-over from war to peace manufacturing conditions is being made as rapidly as possible. During the war period the company has distributed a dividend of 6 per cent. per annum on the ordinary stock for the years 1916 and 1917. The directors now recommend a further distribution of 6 per cent. per annum in respect of the years 1914, 1915, and 1918, which will absorb £18,944. It is also proposed to place to depreciation of buildings and plant £9,400; further 4 per cent. interest on the prior lien participating second debenture stock, £2,045; to general reserve £13,095, and to carry forward £34,714.

**British Ever-Ready Co., Ltd.**—The report for the year ended March, 1919, states that the amount available for appropriation after writing off depreciation, and after making reserve for the purpose of providing for depreciation in value of stock-in-trade, excess profits duties, income tax, and contingencies, is £39,152. Dividend of 10 per cent. for the year on the preference shares, £8,500; 17½ per cent. for the year on the ordinary shares, £20,125; carried forward, £10,527. The excess profits taxation for 1918 has been settled and paid. Including the company's subsidiary undertakings this taxation amounted to £38,525 for the year. Meeting at Holloway, May 30th.

**South Metropolitan Electric Tramways & Lighting Co., Ltd.**—Total revenue £102,092, against £86,139 for 1917. After deducting expenses £7,500 is put to renewals, £5,000 to reserve, the balance of preference dividend for 1917, at the rate of 3 per cent. per annum, also the preference dividend for 1918 at 6 per cent. per annum, are paid, and £1,917 is to be carried forward. The gross receipts from the working of the tramways and light railways increased by £13,665. Motor-'bus receipts, £1,605 net. Gross receipts of the electricity supply section were £22,783, against £21,232 for 1917. Consumers increased by 3 per cent. to 2,522.

**North Metropolitan Electric Power Supply Co.**—Net revenue for 1918 £53,725, plus interest and dividends, making £69,455. After meeting interest charges, putting £2,000 to debenture reserve fund, placing £15,000 to renewals reserve, and paying 6 per cent. cumulative preference dividend, £2,321 remains to carry forward. Revenue from all sources increased by £32,612, but expenses increased by £55,020, of which £50,041 was for increased wages and cost of coal, leaving a decreased net revenue of £22,408.

**The Vickers Issue.**—The "Times" learns that underwriters of the Vickers issue made in connection with the acquisition of shares of the Metropolitan Carriage, Wagon and Finance Co. have been left with 30 or 40 per cent. of the amount. The amount of the issue was £7,000,000 of preference shares and £5,100,000 of ordinary shares, so that about 2,000,000 preference and 1,500,000 ordinary shares will be taken up by the underwriters.

**Chiswick Electricity Supply Corporation, Ltd.**—Revenue for 1918 £31,983, profit £8,558, plus £6,034 brought forward. After meeting debenture interest, paying 6 per cent. dividend, and putting £1,561 to depreciation reserve fund, £685 is to be carried forward.

**Stock Exchange Notice.**—The following are to be officially quoted:—

White (J. G.) & Co., Ltd.—180,000 7 per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 180,000).

**West India and Panama Telegraph Co., Ltd.**—Final dividend of 6d. per ordinary share, and a bonus of 3d. per share, free of tax.

**New Issue.**—*Marconi International Marine Communication Co., Ltd.*—This company has this week been offering to the shareholders 600,000 new shares of £1 each at par.

**Clarke, Chapman & Co., Ltd.**—An extraordinary meeting is to be held on the 23rd inst. to confirm resolutions for the alteration of the articles so as to permit of the capitalisation of surplus profits. Further resolutions will then be submitted (1) to increase the capital to £550,000 by the creation of 250,000 ordinary shares of £1 each and (2) to capitalise £222,030 of the undivided profits and to distribute it in the form of 222,030 fully-paid ordinary shares among the holders or ordinary shares.—*Financial Times.*

**Oldham, Ashton & Hyde Electric Tramway Co., Ltd.**—The ordinary dividend for the year 1918 is 6 per cent., not 7 per cent., as stated last week. £10,000 is put to reserve, and £4,957 is carried forward. In connection with the purchase of the undertaking, it is stated that arrangements are being made to refer to arbitration the question of the price to be paid to the company by the various purchasing local authorities.

## STOCKS AND SHARES.

TUESDAY EVENING.

STOCK EXCHANGE markets continue very animated. The week contains no slack day. Though there are set-backs and reactions, they come up against lines of fresh buyers. Compared with the rises that have occurred since a month ago, the declines have been insignificant. Investment money continues to pour into the markets. Everybody seems to want to know what to buy, and—what is more—will buy the stock if it has reasonable prospects. The war has made the public much more inclined to speculate than of yore; this is the logical result of the decline in the purchasing power of money. So the popular preference share is that which carries participating rights, while the debenture stock upon which interest is paid free of income-tax up to so much in the £ is assured of attentive consideration.

The Electricity Supply Bill just introduced into the House of Commons is of such importance to the industry that, from the merely market point of view, its provisions are hardly grasped, and quotations remain unchanged on the week. The District Boards which are to be set up "must" provide or secure the provision of a cheap and abundant supply of electricity, and are given wide powers to this end. A standard price is to be paid for generating stations and main transmission lines. In the case of a company or individual, the standard price will be the equivalent of the cost of construction, and of the acquisition of the site less depreciation. In default of agreement, the sum to be paid will be determined by a Board of Trade arbitrator. (We hope arbitrators will like working overtime!) The sum of 20 million pounds out of the Consolidation Fund is to be placed at the disposal of the Board of Trade, and the powers of the latter under the Bill are to be transferred to the Ministry of Ways and Communications when this Ministry is established.

The provisions of the Bill are to be put into force with convenient speed after passage of the measure, but with the best of goodwill to expedite matters it is obvious that the change-over will take long to complete. Authorities in the Stock Exchange are inclined to think that things will continue much as they are at present for some considerable period. Any developments in prices will be keenly watched, however, to see if they afford any clue to what is likely to be the attitude of the general body of proprietors in electricity supply companies towards the coming alteration in conditions.

Meanwhile, manufacturing companies and shares are doing well. The British Westinghouse has just issued the best report it has had for four years. It may be recalled that the results for 1917 were disappointing, but these are wiped out by the 1918 figures. The net profit of £146,800 is nearly £60,000 better than that of the preceding year, and the preference receive their new rate of 8 per cent. Preference shareholders have the right to convert into ordinary shares within two years from April 14th last. We have already been asked whether the right thing to do is to convert! With a two years' option, the right thing to do is nothing at present. So far as we are aware, there is no market yet for the ordinary.

The Brush Electrical Engineering has had so good a year that the directors recommend a dividend of 6 per cent. for the years 1914, 1915, and 1918. For the two intervening years, 1916 and 1917, the same dividend was distributed. The company last year made a net profit of £91,098, and the report states that the improved results are due in a measure to the manufacture on a large scale of standardised war products. The ordinary stock keeps good at 82½. The London United Tramways report shows a loss on working of £11,000 before payment of the debenture interest. The Metropolitan Electric Tramways took £84,800 more in receipts, and paid away £83,900 more in working expenses. Such figures may be commended to the notice of those journalists who are "stunting" the so-called traffic scandal.

General Electrics have gained £3 at 22. Edison Swans have been strong on the basis of 23s., and the new shares spurted to 1s. 6d. premium. Electric Constructions are a good market around 25s. 9d. Westinghouse preference have risen to 2⅞. Abroad, it is interesting to notice that the River Plate Electricity Co. has had to fall back upon part of last year's carry-forward in order to maintain the dividend on the ordinary stock at the regular rate of 7 per cent.

The Marconi International Marine is offering its shareholders 600,000 new shares of £1 each at par, share for share. This makes a handsome bonus, and the new are quoted 2 5/16 premium, while the old have risen to 3 5/16 ex the rights. Marconis are also higher at 5 9/16, the preference at 4⅛, a wave of profit-taking being countered by an influx of buying orders. Canadians jumped to 17s. 6d.

Cable stocks and shares have again advanced, thanks to the increase in the Globe Telegraph & Trust dividend. Eastern ordinary gained 5 points at 167½, and Eastern Extensions at 16⅛, Westerns at 17½ are ⅛ and ¼ higher respectively, while Globes have spurted to 16½.

Toronto Power 4½ per cent. debenture is 3 higher at 84. Brazil Tractions are again a point better. A timid recovery in British Columbia Electric deferred followed upon the recent severe fall. Mexicans remain depressed. The Auckland Electric Tramways Co. has given an option to the Auckland (N.Z.) Corporation to buy the undertaking. In the winding-up of Fraser & Chalmers, it has been decided by Mr. Justice Astbury that surplus assets must be rateably distributed between the ordinary and preference shareholders—rather a blow to the hopes of the former class. The rubber share market has yielded a little of its strength, and amongst armament shares, Vickers eased off on the prospects of selling by underwriters who had to take 30 or 40 per cent. of their obligations under the new issue. Babcock & Wilcox at 4 are 5s. better, and at 35s. British Aluminiums show 1/16 gain. London and Suburban Traction preference are dull on the report showing no dividend on the preference shares in respect of the past year.

## SHARE LIST OF ELECTRICAL COMPANIES.

| | Dividend 1917. | Dividend 1918. | Price May 13, 1919. | Rise or fall. | Yield p.c. |
|---|---|---|---|---|---|
| **HOME ELECTRICITY COMPANIES** | | | | | |
| Brompton Ordinary | 10 | 8 | 62 | — | £5 8 16 |
| Charing Cross Ordinary | 4 | 4 | 82 | — | 5 18 4 |
| do. do. do. 4½ Pref. | 4½ | 4½ | 92 | — | 6 18 4 |
| Chelsea | 5 | 8 | 81½ | — | 4 1 1 |
| City of London | 8 | 8 | 112 | — | 6 16 2 |
| do. do. 6 per cent. Pref. | 6 | 6 | 10 | — | 6 0 0 |
| County of London | 7 | 7 | 104 | — | 6 18 3 |
| do. do. 6 per cent. Pref. | 6 | 6 | 97 | — | 6 3 1 |
| Kensington Ordinary | 7 | 6 | 64 | — | 5 2 3 |
| London Electric | Nil | Nil | 1½ | — | Nil |
| do. do. 6 per cent. Pref. | 5 | 6 | 84 | — | 7 14 10 |
| Metropolitan | 4 | 5 | 84 | — | 5 0 0 |
| do. 4½ per cent. Pref. | 4½ | 4½ | 82 | — | 6 18 6 |
| St. James' and Pall Mall | 9 | 10 | 72 | — | 7 0 4 |
| South London | 5 | 5 | 84 | — | 7 5 6 |
| South Metropolitan Pref. | 7 | 7 | 20/6 | — | 6 16 7 |
| Westminster Ordinary | 9 | 8 | 64 | — | 6 3 1 |
| **TELEGRAPHS AND TELEPHONES.** | | | | | |
| Anglo-Am. T 1. Pref. | 6 | 6 | 98½ | — | 6 1 10 |
| do. Def. | 1½ | 53/8 | 22½ | — | 7 8 0 |
| Chile Telephone | 8 | 8 | 72 | — | 5 8 6 |
| Cuba Sub. Ord. | 7 | 7 | 114 | — | *6 7 4 |
| Eastern Extension | 8 | 8 | 165 | +2 | *4 16 8 |
| Eastern Tel. Ord. | 8 | 8 | 167½ | +5 | *4 15 7 |
| Globe Tel. and T. Ord. | 7 | 8 | 164 | +1½ | *4 19 3 |
| do. do. Pref. | 6 | 6 | 104 | — | 5 14 8 |
| Great Northern Tel. | 22 | 22 | 304 | — | 7 4 0 |
| Indo-European | 13 | 13 | 87½ | — | 5 13 6 |
| Marconi | 20 | 20 | 5 5/16 | +5/16 | 3 12 0 |
| Oriental Telephone Ord. | 10 | 15 | 24 | — | 6 3 0 |
| United R. Plate Tel. | 8 | 8 | 76 | — | *5 1 7 |
| West India and Panama | 1/8 | 1/8 | 1½ | +1/16 | *4 3 4 |
| Western Telegraph | 8 | 8 | 178 | +⅛ | *4 12 5 |
| **HOME RAILS.** | | | | | |
| Central London Ord. Assented | 4 | 4 | 63½ | — | 6 6 0 |
| Metropolitan | 1 | 1½ | 28 | +1 | 4 9 3 |
| do. District | Nil | Nil | 25 | +1½ | Nil |
| Underground Electric Ordinary | Nil | Nil | 8½ | —⅛ | Nil |
| do, do, "A" | Nil | Nil | 9/- | —3d. | Nil |
| do. do. Income | 4 | 5 | 95½ | —½ | *5 4 9 |
| **FOREIGN TRAMS, &c.** | | | | | |
| Adelaide Sup. 6 per cent. Pref. | 6 | 6 | 48 | — | 6 11 4 |
| Anglo-Arg. Trams. First Pref. | 5½ | Nil | 8½ | — | — |
| do. do. 2nd Pref. | — | — | 8 | — | — |
| do. do. 5 Deb. | 5 | 5 | 68½ | — | 7 8 5 |
| Brazil Tractions | — | — | 59 | +1 | — |
| Bombay Electric Pref. | 6 | 6 | 102 | — | 5 11 7 |
| British Columbia Elec. Rly. Pfce. | 5 | 5 | 59 | — | 8 10 0 |
| do. do. Preferred | Nil | Nil | 40½ | —1 | Nil |
| do. do. Deferred | Nil | Nil | 32½ | — | Nil |
| do. do. Deb. | 4½ | 4½ | 62 | — | 6 17 4 |
| Mexico Trams 5 per cent. Bonds | Nil | Nil | 60 | — | Nil |
| do. 6 per cent. Bonds | Nil | Nil | 46 | —1½ | Nil |
| Mexican Light Common | Nil | Nil | 37 | — | Nil |
| do, Pref. | Nil | Nil | 51 | — | Nil |
| do, 1st Bonds | Nil | Nil | 67 | — | — |
| **MANUFACTURING COMPANIES.** | | | | | |
| Babcock & Wilcox | 15 | 15 | 4 | +¼ | 3 15 0 |
| British Aluminium Ord. | 10 | 10 | 13 | +1/16 | 5 14 3 |
| British Insulated Ord. | 25 | 12½ | 2 1/16 | — | 6 1 1 |
| British Westinghouse Pref. | 7½ | 8 | 28 | +⅛ | 6 2 0 |
| Callenders | 25 | 25 | 10 | — | 6 5 0 |
| do. 6½ Pref. | 5 | 6½ | 12 | — | 6 3 10 |
| Castner-Kellner | 25 | 20 | 8½ | — | 6 2 1 |
| Edison-Swan, "A" | — | — | 1 3/16 | +1/16 | 6 6 4 |
| do. do. 5 per cent. Deb. | 4 | 5 | 75½ | — | 6 12 8 |
| Electric Construction | 10 | 10 | 1 3/16 | +1/16 | 7 16 0 |
| Gen. Elec. Pref. | 6 | 6½ | 10⅜ | — | 6 5 4 |
| do. Ord. | 10 | 10 | 22 | +2 | *4 11 6 |
| Henley | 25 | 25 | 24 | — | 5 0 0 |
| do. 4½ Pref. | 4½ | 4½ | 32 | — | 6 16 2 |
| India-Rubber | 10 | 10 | 16⅜ | — | *6 0 4 |
| Siemens Ord. | — | 10 | 6 1/16 | +1/16 | *7 4 0 |
| Telegraph Con | 20 | 20 | 25 | — | 4 15 0 |

*Dividends paid free of Income Tax.

# AN ELECTRICAL DEVICE FOR CHECKING THE STEAM CONSUMPTION OF SMALL-POWER MIXED-PRESSURE TURBO-GENERATORS.

By J. B. HARRISON.

The labour difficulty during the period of the war has led to the introduction of many electromechanical devices with a view to meeting the reduction in staff, or to compensating for the poor quality of the labour available.

The privately-owned power systems of works or mills employing steam turbines of 500 to 1,000 KW. capacity have been particularly hard hit from this point of view; I may quote a case coming under my control in which all the original staff was called up for military service during the early period of the war, and I had to employ any class of labour that was available to keep up the power supply.

The supply was maintained with reasonably good results, but on checking the coal consumption, I found that it was going up out of all proportion to the output of the generator, and this, coupled with the increasing difficulty of obtaining coal, and the rising price per ton, made it imperative that some action should be taken.

The plant under review was of the mixed-pressure turbine type, and I found that I had to be constantly visiting the power house to check the steam consumption; but as I could not spare the time for constant visiting, I tried various devices to record the steam consumption, and eventually developed the following arrangement, which affords a direct check on inattention on the part of the man in charge of the plant.

With a purely high-pressure turbine the position of the valves would follow more or less the KW. output of the generator, but in the case of mixed-pressure machines the position of the high-pressure valves is controlled from two sources, viz., the KW. output of the generator and the volume of low-pressure steam available at the time. The efficiency of the mixed-pressure turbine to which I am referring depends to a great extent on the human element, as the low-pressure auxiliary valves have to be periodically adjusted to meet the conditions.

When the turbine is started up, all the high- and low-pressure valves are open, and the spindle S M S of the servomotor (see fig. 1), the movement of which is directly proportional to the position of the valves, is in the bottom position; the lever B, which rests on S M S, moves up and down in correspondence with the movement of the valves.

Attached to one end of the lever B a contact C B is fixed which travels up and down the face of the commutator C S, the function of C B being to cut out the resistance R as the lever B rises.

Fig. 1 shows the commutating device and the turbo-servomotor.

Fig. 2 shows the recorder chart, upon which the position of the valves is indicated by the movement of the pen. As the valves close, the resistance R is gradually cut out of the recorder circuit, and the pen moves over the chart, recording the position of the valves in four steps per valve.

The voltage of the supply is practically constant, therefore the only variation of the movement of the pen is due to the amount of resistance in the circuit at R.

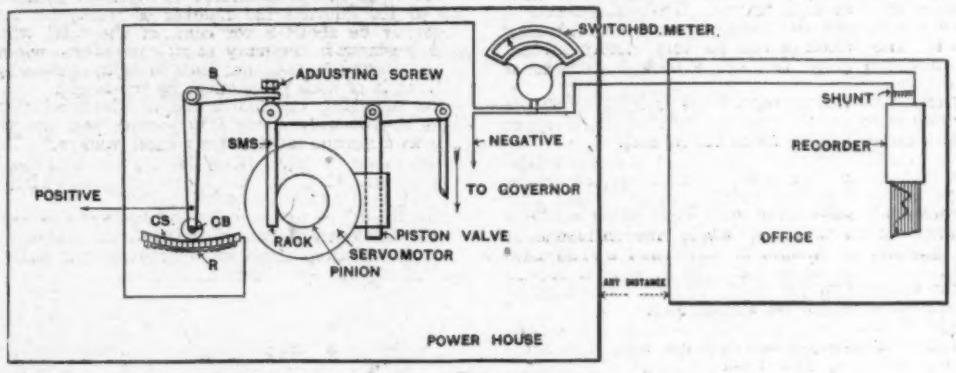


Fig. 1.

An indicating instrument (see fig. 1) can also be incorporated in the scheme; this can be of the usual voltmeter pattern, but the scale is recalibrated (fig. 3), and it can be fixed on the switchboard so that the switchboard attendant is also able to observe the operation of the steam side of the turbine.

The controlling switch on the turbine is completely enclosed in an ironclad case, and cannot be tampered with by an unauthorised person.

The device consumes practically no current, and is simple for installing, provided that one is in possession of a recording ammeter of the shunted type. This arrangement has proved its value in actual practice from the point of view of knowing exactly the position of the valves, as the valve curves can be compared with the KW.-output curves of the generator at any time when the generator is working.

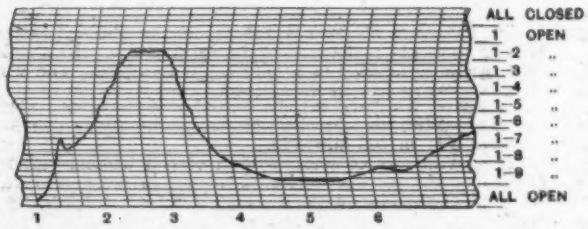


Fig. 2.

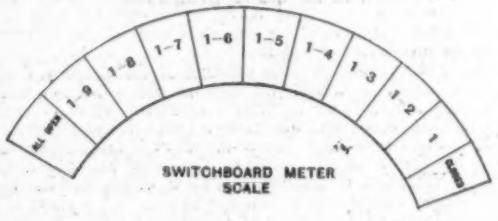


Fig. 3.

**Experiments on Electric Shock.**—Experiments have proved that low-pressure electricity in sufficient quantity may be dangerous to life on account of palpitations induced in the ventricles of the heart, says the *Engineer*; A.C. with a periodicity of 35 to 50 cycles is four times more dangerous than D.C. Experiments in France showed that 100 milliamperes of A.C. at a pressure of 100 volts would kill a dog in a few seconds, while 400 to 500 milliamperes of D.C. could be applied before death occurred. The effect of very high pressures ranging from 10,000 to 50,000 volts is similar to that of low pressures because of the potential fall set up by the electric arc formed between the body and the electrical conductor.

# LARGE POWER TRANSFORMERS.

By A. G. ELLIS, A.M.I.E.E., and J. L. THOMPSON, M.Sc., A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

(*Concluded from page* 546.)

From the manufacturer's point of view both core and shell type transformers can be satisfactorily built for either single-phase or three-phase.

The core type as usually constructed lends itself better to small and high-tension units, as small conductors can be better wound in circular coils and the insulating problem is simplified. For medium size units the three-phase core type makes a satisfactory job, but in very large units the bracing and cooling become quite problems. In large units it will generally be preferable to split up into three single-phase units forming a three-phase group.

The shell type is generally preferable for single-phase units except for small sizes at high voltage. The construction is simpler, more robust, and less liable to damage in handling and transport. The windings can be very rigidly braced, and the construction gives very large cooling surfaces of windings and core.

Regarding electrical performance, there is little to choose between the two types for the same amount of active copper and iron. Also there is little difference in cost.

From the standpoint of service requirements the core-type windings are in general more liable to shrinkage, as insulation is always under a permanent compressive stress. This is not so aggravated in the case of single-layer spiral windings of copper strip wound on edge, where the shrinkage is practically negligible. In section or coil-wound transformers the total shrinkage after twelve months in general service may be of the order of 2¼ per cent., *i.e.*, 1 in. in 40 in. of winding length for a 20,000-volt transformer.

In shell-type transformers the expansion of the copper is much less than in core-type transformers, and there is no compression due to the weight of the coil, and consequently no periodic adjustment of the coil supports is necessary under normal service conditions.

Some form of coil support is essential in all transformers; and, further, it may be necessary to provide means of adjustment to compensate for the shrinkage.

Means for automatically compensating the shrinkage in the windings of core-type transformers generally take the form of spiral springs arranged so as to exert an axial thrust on the coils tending to oppose directly any axial movement due to the shrinkage of the insulation.

While such springs undoubtedly follow up any shrinkage that may occur, the more the springs expand, the lower the pressure they are able to resist without movement. Consequently the windings, even during normal operation, may be in a state of permanent vibration, and, under abnormal conditions, may be subjected to considerable movement. Any such movement is naturally undesirable. The spring should be so placed relatively to the windings that the weight of the latter exerts no pressure which would counteract the effect of the spring.

Another disability of the use of springs relates to core-type transformers with very long cores, especially for high voltages and large outputs, where the shrinkage of the windings may be as much as 1 to 1½ in.

A spring able to follow this amount of shrinkage and still be able to exert sufficient pressure on the windings would lead to complicated and inefficient construction and involve loss in winding space and higher core loss. While the springs provide adjustment the above-mentioned disabilities outweigh, in the authors' opinion, the resulting advantages claimed. Vibration or movement due to shock can be overcome if some means are provided whereby the spring, after having performed its function of following up the shrinkage, is prevented from any possible recoil due to sudden shock. An arrangement due to Mr. G. Harlow which achieves this end is shown in fig. 4. It consists essentially of a spring which surrounds the plunger of a small dashpot and exerts pressure between the dashpot and its plunger. The plunger is supported on the top frame of the transformer and the dashpot transmits the pressure of the spring on to the windings. The dashpot is provided at the back end with a small hole serving as an oil inlet and escape. When shrinkage of the windings takes place this is followed up by the spring acting on the plunger, and any possible sudden recoil is prevented by the sluggish action of the dashpot and plunger.

In the shell type, shrinkage is practically negligible, and automatic adjustment is unnecessary.

Given first-class design and manufacture, there is in general very little to choose between core-shell types. The choice of type from this standpoint and the ultimate result depends largely on the individual manufacturing facilities.

In the shell-type the voltage per turn is considerably higher than in the core type. The insulation between turns must be heavier for shell-type designs, and this becomes more important in very large outputs.

The reinforcement of the insulation of the end turns is to some extent easier in shell-type designs, as the total number of turns is smaller and fewer turns have to be reinforced. For power systems with underground cables the end-turn reinforcement is less important than in transformers connected to overhead transmission lines subject to atmospheric disturbances. Up to a voltage of 30 kilovolts, experience shows that reinforcement to the extent of about 1 per cent. of the winding per 10 kilovolts of line voltage is sufficient, *i.e.*, for 30 kilovolts 3 per cent. of the winding from each line terminal is reinforced. The reinforced insulation should be of sufficient strength to withstand normal line voltage momentarily between adjacent turns, in about 1 per cent. of the winding.

For transformers connected to overhead transmission lines up to 100 kilovolts the number of reinforced turns should generally be about 5 per cent. of the total winding. The reinforcement is necessary at all ends of the windings which are connected to the line; thus in delta-connecting windings both ends of each phase must be reinforced.

On switching in, the period of abnormal voltage stress lasts usually only about 1/10 second, and the voltage may rise to a maximum of twice normal voltage.

The curves in fig. 5 show the relation between breakdown voltage and time for sheet insulating materials commonly used in transformer construction.

The insulation between the end turns of the winding needs to be sufficiently thick to withstand full voltage for, say, one second, which corresponds to about 60 per cent. of normal voltage applied for 1 minute or more.

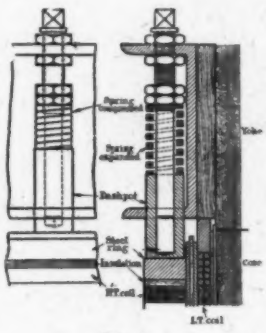


Fig. 4.

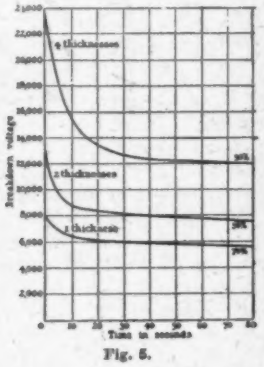


Fig. 5.

FIG. 4.—SPRING COIL SUPPORTS WITH DASH-POT TO PREVENT RECOIL OF SPRING.

FIG. 5.—RELATION OF BREAKDOWN VOLTAGE AND TIME FOR SHEET INSULATING MATERIALS.

On the score of general robustness the shell-type transformer presents a much stronger construction which is less susceptible to damage in handling and transport. The windings are well anchored and braced.

Core-type windings can be braced and supported almost as rigidly, but this involves elaborate and costly details of construction in coil supports.

In general any elaborate system of coil bracing either in shell-type or core-type transformers, involves a certain amount of sacrifice in electrical performance and increase in cost.

Special mechanical attachments for coil bracing are not generally necessary for transformers for normal service on systems under about 20,000 K.V.A., but are desirable on large transformers and on large systems, or in cases where the operating conditions are severe.

On an 8,000-K.V.A., 25-period, single-phase, shell-type transformer having 6 per cent. impedance voltage, the maximum total stress over the whole of the surface of each end coil is approximately 300 tons under short-circuit conditions. This amounts to about 3 tons per sq. in. of coil surface.

On a 5,000-K.V.A., three-phase, core-type transformer the axial stress between H.T. and L.T. concentric windings may amount to 200 tons per leg under short-circuit conditions. The circumferential stress in the outer concentric coils is of the order of 8 tons per sq. in. of copper section. The strength of the copper in the windings is usually sufficient to resist this hoop stress.

The protection of transformers against mechanical damage due to short-circuits has become of increasing importance with step-up transformers situated directly on the station busbars, and distributing transformers situated often relatively near to the power station.

Mechanical strains may be restricted by limiting the short-circuit current, by introducing a sufficiently high impedance in the circuit.

Actually external reactance is more efficacious, since, with the same limitations of short-circuit current, the mechanical stresses on the windings are less than those produced when the same current limitation is obtained by internal reactance.

Questions of costs, space, and simplicity weigh against this consideration. It is quite possible, by designing the transformer with a suitable amount of inherent reactance, to limit the short-circuit stresses to such a value as can be safely dealt with by a robust mechanical construction. This is the general tendency of modern practice.

Where it is necessary or desirable to install external protective reactances, the following general considerations should be taken into account.

The ironclad type consists of a choke coil with an iron core similar to a standard transformer but with a large air-gap, or a number of small air-gaps interposed in the path of the magnetic flux.

The air-core type consists simply of a plain coil in air, the inductance of which is designed to give the required choking effect without the use of an iron core. Either type can be built to give satisfactory service. The choice depends mainly on the type of service obtaining, and on the location and space available.

As regards the type of service, the choice reduces itself largely to a question of capital cost; the relative prices depend on the short-circuit current required in terms of the normal current.

Busbar reactances are usually arranged to limit the current transference from one section to another to about 4 to 5 times the normal current in each set of busbars, corresponding to a voltage choke in the reactance of 25 to 20 per cent. of the line voltage.

In generator reactances the current limitation is usually about eight times the normal current, which, allowing for

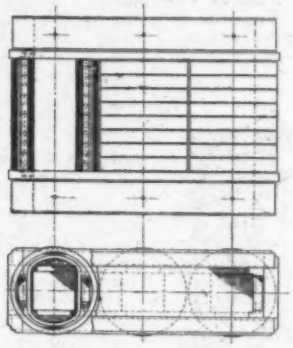

Fig. 6.—High-reactance Transformer for Rotary Converter.

7.5 per cent. inherent reactance in the generator, requires an additional 5 per cent. external reactance, or a total of 12.5 per cent. reactance.

Feeder reactances are generally proportioned for a smaller voltage drop of about 5 per cent., corresponding to a current limitation of 20 times normal.

The cost of such reactances increases with the value of the current limitation for a given normal current. This consideration does not arise in the air-core type, but in point of cost the ironclad type can be designed to compare favourably with the air-core type up to limiting currents of about eight times normal.

In this respect the ironclad type has the advantage over the air-core type in that there is no stray field. Air-core reactances should be so installed that there is no iron-work nearer than a distance approximately equal to the overall diameter of the coil.

This is often an important factor where the space available is limited, as is generally the case in older stations where extensions necessitate the use of such apparatus.

The safety factor of the insulation on the windings of transformers is an indeterminate quantity in such portions of the windings as may be subjected to uncontrollable electrical strains during operation. In this case, so far as can be predetermined from experience, an ample safety factor is provided for, by means of reinforcement of the insulation between turns. The greater part of the winding is not subjected to such conditions, and here the safety factor of the insulation may be approximately determined from knowledge of the properties of the insulating materials and the test conditions.

The average operating safety factor of insulation between turns (based on the normal working voltage) is from 166 to 900. This factor may seem high, but it is determined by the minimum practicable thickness of insulation.

From the manufacturer's standpoint the safety factor must be reckoned on the test voltage to which the transformer is subjected.

Usually transformers are submitted to an overpotential test of 2 to 2½ times normal voltage for a period of one minute. Hence the factory safety factor (based on the test voltage) is of the order 83 to 450.

It is possible to insulate up to almost any voltage between coil sections required in service by means of solid insulation. This method has its limitation as the size of the transformer increases.

In coils of radial depth greater than about ¾ in. to 1 in., it is necessary to introduce ventilating ducts for the cooling medium to circulate, which themselves lead to an improved insulation between sections.

TABLE III.

| Working pressure. | Approximate breakdown pressure. | Operating safety factor. | Test pressure.* | Factory safety factor. |
|---|---|---|---|---|
| kv. | kv. | | kv. | |
| 22 | 40 | 18·2 | 5·4 | 7·4 |
| 66 | 60 | 9·1 | 14·2 | 4·25 |
| 11 | 80 | 7·25 | 23 | 3·5 |
| 22 | 110 | 5·0 | 45 | 2·45 |
| 33 | 140 | 4·25 | 47 | 2·1 |
| 55 | 200 | 3·65 | 111 | 1·8 |

* B.E.S.A. standard test voltage = 1,000 volts + 2 × normal voltage.

Table III shows the average breakdown voltage for the insulation usually employed between H.T. and L.T. windings and between windings and frame.

Similar data for insulation between windings and the inside surface of the tank give a safety factor to earth through the oil of from 5 to 3 for the operating safety factor, and 2½ to 1½ for the factory safety factor based on a disruptive strength of dry oil of 15,000 volts between needle points ¼ in. apart at 15 deg. C.

The creeping distance over the surface of porcelain terminal insulators should be so proportioned as to allow an operating safety factor of about 3 and a factory safety factor of about 1½; that is, the flash-over voltage of such insulators should be about three times the working voltage, or 1½ times the test voltage of the transformers.

Fig. 7.—Packet of Iron for Magnetic Shunt for High-reactance Transformer.

The mechanical parts of a transformer subjected to stresses from the windings are proportioned for the usual safety factors employed in machine design.

In well-designed transformers the maximum temperature occurring at any point on the winding should not exceed the average temperature in the windings by more than about 5 deg. C.

The service conditions in the interlinking of power systems differ from those of ordinary sub-station step-down transformers.

The usual means of obtaining the requisite voltage regulation consist either of tappings on either or both sides of the transformer for, say, 2½ and 5 per cent. above and below

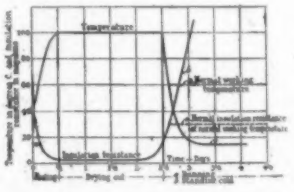


Fig. 8.—Variation of Insulation Resistance with Temperature and Time.

normal voltage, or of some form of voltage regulator if a wide range or frequent adjustment is required.

In the case of two-phase or three-phase systems interlinked at one point the connections of the interlinking transformer are of no consequence unless there are more than two stations interlinked.

In ring connection the question of phase relation enters. Star connection is generally preferable.

Transformers for use with rotary converters are worthy of special mention in that they in many cases require special electrical characteristics which are not met with in standard power transformers. Where the voltage on the D.C. side of the converter is obtained by means of static or synchronising boosters, the main transformers are of identical design and construction with standard power transformers. When the D.C. voltage regulation is obtained by means of field regulation, the transformer must be provided with sufficient internal reactance to meet the peculiar requirements. The transformer reactance voltage required may range from 5 to 30 per cent.

With shell-type transformers the coil grouping can be easily varied, and internal reactance voltages of from 8 to 10 per cent. for a 500-K.V.A., up to 12 to 15 per cent. for a 1,000-K.V.A. transformer, can be obtained. Above these values magnetic shunts generally have to be resorted to in order to attain the extra reactance required.

With core-type transformers the value of the reactance required is readily obtainable up to any required value by means of the coil grouping and suitable spacing of the primary and secondary windings.

This method was superseded by magnetic shunts consisting of a sheet or sheets of iron arranged concentrically between H.T. and L.T. windings. To avoid trouble due to the magnetic saturation of the magnetic shunts introduced into the transformer, a new type of magnetic shunt of multiple-gap construction was designed and patented by the authors.

A large number of transformers built with this type of magnetic shunt are in commission and building, ranging in size from 165 to 2,200 K.V.A. for 150 to 2,000-KW. rotary converters.

Transformers of this type give a high degree of utilisation of active material compared with the older types, and they are easily designed to have a straight-line volt-ampere characteristic. They also present a robust construction and have reduced losses and improved efficiency, with a resulting saving in annual charges.

A transformer of this type compared with that of the old type, either with sandwich winding or saturated magnetic shunts, would have a copper or load loss of only about two-thirds of that of the older types, and a corresponding improvement in efficiency. This type of construction is illustrated in fig. 6, and also in fig. 7, which shows a built-up magnetic shunt for one side of the core of a 1,650-K.V.A. transformer.

The switching in and out of transformers may present difficulties unless the transformer is correctly designed. The correct way to switch in is slowly to close the switch, during which interval the distance between the contacts becomes smaller until the voltage causes the current to jump across the gap. This jump will take place at or near the point of maximum voltage, which is the point of the wave desired for minimum current rush.

If the switch is closed at the maximum point of the voltage wave no rise of voltage will be experienced unless the core has residual magnetism. In modern transformers the possible voltage rise will not exceed 1.6 to 1.8 times normal voltage unless the flux density is low, when it may reach a value up to 3 to 5 times normal voltage under adverse switching conditions. This latter condition is rarely met with except in high-frequency transformers. A similar result occurs when switching out a transformer. Frequent or unnecessary switching should be avoided and transformer switches should be closed slowly. By taking the above precautions it is quite possible to switch large and high-voltage transformers directly on to the line without danger.

All transformers of moderate and high voltage should be dried out before being put into service. The insulation resistance should be measured during the drying-out period, and the values should follow characteristics similar to the curve shown in fig. 8, which shows variations for oil-immersed transformers before, during, and after drying out, if the process is proceeding satisfactorily.

"Megger" readings of the insulation resistance values, while useful, are not safe.

It is desirable, as far as possible, to ship transformers in their tanks ready for service, the drying out being done before leaving the factory.

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**The Housing Problem in the United States.**—According to the American Society for Electrical Development, because of the Government restrictions placed on building materials during the war, there have been practically no dwellings erected in the past two years. The average number of buildings erected yearly before the United States entered into the war was between 300,000 and 350,000. Building contractors base their calculations for the next twelve months on the erection of not fewer than 700,000 new homes. There are said to be, in the city of New York alone, 30,000 families searching hopelessly for homes. And New York reflects the situation in other large cities. It was believed by many that there would be a surplus of labour, and that with restrictions off the prices of building materials would decline. On the contrary, labour wage is almost certain to remain at its old scale—if it does not climb still further; in fact, in the New York papers of March 20th appeared the notice of an increase of one dollar per day to all classes of labour in the building trades. This was the decision of Supreme Court Justice P. Henry Dugro, umpire, selected by the Building Trades Association and the United Brotherhood of Carpenters and Jointers to consider their dispute over wages. It is certain that prices, in the future, will be at even a higher level. In addition to the proposed construction of new houses, thousands of homes, more than the annual average number, are booked for remodelling, redecorating, and other renovating. In view of these facts, the Society for Electrical Development of New York City has inaugurated a national campaign, scheduled for April 1st to May 15th, called "Electrify Your Home," which is intended to stimulate trade activities.

## ELECTRIC FURNACE PRACTICE.

At a joint meeting of the Institution of Electrical Engineers and the Iron and Steel Institute on May 8th, six papers on electric furnaces were discussed. Abstracts of the papers are given below :—

### Electric Furnaces in the United Kingdom, 1918.

By R. G. MERCER, M.I.E.E.

This paper deals chiefly with the operation and output of the various types of furnaces under actual working conditions. The main object is to give information which may tend to increase the general efficiency of electric steel furnaces in this country.

There are installed, or being installed, 141 electric furnaces with a total capacity of 112,000 K.V.A. Of these, 24 are, or will be, used for Swedish substitute, cupro nickel, alundum, manganese copper, and ferro alloys. The remaining 117 are electric steel furnaces having a total charging and K.V.A.-capacity of 384 tons and 98,769 K.V.A. respectively, and a total nominal output of 31,170 tons per month, based on five days a week, four weeks per month. Assuming that all these furnaces are working at full load, the total nominal output at the end of a year would be 405,000 tons.

TABLE I.—Electric Steel Furnaces in the United Kingdom.

| Make. | Number of furnaces. | Total tons, size. | Total K.V.A. | Nominal tons output per month. |
|---|---|---|---|---|
| Electro-Metals ... ... | 27 | 73 | 20,274 | 6,740 |
| Greaves-Etchells ... | 26 | 64½ | 18,830 | 5,680 |
| Héroult ... ... ... | 45 | 180½ | 43,220 | 13,760 |
| Rennerfelt ... ... | 4 | 7 | 1,895 | 750 |
| Snyder ... ... ... | 6 | 9½ | 3,150 | 1,200 |
| Special ... ... ... | 2 | 2 | 750 | 280 |
| Stassano... ... ... | 2 | 2 | 600 | 240 |
| Stobie ... ... ... | 5 | 45½ | 10,050 | 2,600 |
| Total ... ... | 117 | 384 | 98,769 | 31,250 |

The actual charge is in most cases, especially in the case of 6-ton furnaces, greater than the rated charge. The actual output, giving the best month's output of each furnace is purposely taken, and is 65 per cent. of the nominal output. Assuming that the furnaces to be installed have an actual output of 65 per cent., the actual output per month would be 2,028 tons, making a total of 7,047 tons per month, or 91,637 tons in the ladle per annum, for castings, against a total nominal output of 140,920 tons per annum. The furnaces are mostly working on day shift. The actual output is purposely taken from the best month's output of each furnace, and is 78 per cent. of the nominal output. Assuming these had a ratio of 78 per cent. actual to nominal output, the actual output would be 2,410 tons per month. These furnaces represent those sanctioned by the Ministry of Munitions of War and do not include those ordered since November, 1918, after which date sanction was not required.

On the above assumption, we have in this country furnaces capable of producing a total possible output of over 300,000 tons of electric steel per annum with 98,769 K.V.A. behind them. Taking the average output per month over a period of time we get very different results, as follows :—

| | Nominal. | Actual. | % |
|---|---|---|---|
| Castings ... ... ... ... | 7,720 | 3,557 | 46 |
| Ingots ... ... ... ... | 16,530 | 9,855 | 59 |

Comparing these with the best month's outputs there is a difference in each case of 19 per cent. Delays are largely responsible for this.

The author found that while some users kept proper records of the operation and output of their furnaces, others confined themselves to the output, and kept no proper records of current and electrode consumption or causes of delays.

It was decided, therefore, to send out electric furnace log-sheets to all users, and to ask for fortnightly returns to be made to the Ministry of Munitions. Instead of giving full particulars of each individual heat, the total number over a fortnight was given. These, with the particulars previously given, were sufficient for the requirements of the Ministry, and enabled the latter to note especially those furnaces which were not operating well, and the reason. The results are embodied in a number of tables in the paper; the figures, taken over a period of one to six months, show the comparative performance of furnaces working as nearly as possible on the same class of steel, and under similar conditions in the various steel works.

In making comparisons the author considers it to be necessary to take furnaces having the same K.V.A. capacity, and not the rated charging capacity in tons. The heats per day in the table are the average number of heats taken over the whole period of 20 days a month, and include "delays." Under "best month's output" the average number of heats per day are shown with "no delays."

After a careful comparison of the various sizes and types of furnaces, the author has arrived at the results given in Table II.

TABLE II.—Ratings of Electric Furnaces.

| Ingots or castings. | Size, tons. | K.V.A. | Average hours per heat. | Number of heats per day. | Nominal tons per month of 20 days. |
|---|---|---|---|---|---|
| Ingots ... | ½ | 250 | 2·75 | 7 | 70 |
| Castings ... | ½ | 250 | 2·25 | 8 | 80 |
| Ingots ... | 1½ | 500 | 3·25 | 6 | 180 |
| Castings ... | 1½ | 500 | 3 | 7 | 200 |
| Ingots ... | 2-2½ | 650 | 4·25 | 5 | 220 |
| Castings ... | 2-2½ | 650 | 3·5 | 5 | 240 |
| Ingots ... | 3-3½ | 850 | 5·75 | 4 | 280 |
| Castings ... | 3-3½ | 850 | 4·75 | 4 | 280 |
| Castings ... | 5 | 1,000 | 4 | 5 | 500 |
| Ingots ... | 6 | 1,500 | 7·5 | 3 | 360 |
| Ingots ... | 7 | 1,800 | 7·5 | 3 | 420 |
| Ingots ... | 10 | 2,500 | 7·5 | 3 | 600 |
| Ingots ... | 15 | 3,000 | 7·5 | 3 | 900 |

The nominal output per month is based on the assumption that the weight of charge is equal to the rated charging capacity of the furnace. In actual practice, however, this is not the case in many furnaces. The 6-ton furnaces, for instance, take from 6·8 to 10·2 tons per charge on the average. Consequently the actual output is increased, though the heat period would increase and the average number of heats per day might be less than the above estimate. The author sees no reason why the above outputs should not be easily reached under proper conditions. While it is difficult where there are a number of furnaces working together to arrange things so that they may be teemed as and when ready, it should not be difficult for a single furnace to get the necessary attention. Failure due to breakdown of generating plant and lack of spare plant occurred in one or two cases. The generating stations were working at their maximum capacity and were at times severely overloaded. The result was that when shortness of supply happened, the first plant to be shut down, with little or no notice, was the electric furnace. It was easier to shut down than a lot of small and not so important users. There is no doubt that all the users of electricity were doing important work during the war, but very much less consequental damage and interference would have resulted if the furnace user could have been kept going until he had at any rate a chance of cleaning his furnace so as to prevent a possibility of freezing. When this was pointed out the supply engineer always showed his keen appreciation and, although at his wits' end to try to accommodate everybody, he most certainly gave the electric furnaces first consideration. The author thinks a debt of gratitude is due to the various corporations and other electric supply departments. Like the Navy they worked silently, and their existence was chiefly brought to mind when anything adverse happened.

Delays due to breakdown of furnaces have been far too frequent. In the author's opinion the tilting gear and general arrangement of electrode feed-gear on certain types have not been designed to withstand the conditions in a steel works. He has many records of stripping on the tilting gear, of stripping of the electrode gear, and every possible transformer trouble. The makers concerned are eliminating these bad features. If the reliability can be improved it will certainly pay the user to have his furnace brought up to date as far as possible.

Water-cooled collars at the electrode entrance in the roof have been a source of constant trouble and delays. Their breakdowns are undoubtedly due chiefly to failure of water supply.

Electrode holders of certain types also give a lot of trouble. Personally, the author has no use for a water-cooled electrode holder; its use is an admission that it is exposed to hot gases. If electrodes (especially amorphous carbon) are operated at a proper current density, and assuming they are not of inferior quality, the holder should be able to carry the necessary current without undue heating. Against this it may be argued, and with some reason, that where, say, a furnace is fitted with 14-in. amorphous carbons, which at a current density of 25 amps. per sq. in. should carry about 4,000 amps. each, the user nearly always runs them at 5,000 or 6,000 amps. The user may say, in explanation, that he cannot otherwise get his heat in the furnace (there is plenty outside). The answer is that he should either put in a larger electrode if the furnace can take it or one be got for, say, 8-in. graphite, which with a current density of 100 amps. per sq. in. will enable him to run at 5,000 amps. per phase. It may further be argued (and again with some reason) that amorphous carbons are very often of inferior quality, and it very often happens that while one batch may be good the very next batch out of the same heating furnace may be very inferior.

Table III shows the total amperes which amorphous or graphitic carbons should carry at a current density of about 25 to 100 amp. per sq. in. respectively:—

TABLE III.

| Diameter of electrode (in.). | | Amperes per electrode. | |
|---|---|---|---|
| Graphite. | Amorphous. | Graphite. | Amorphous. |
| 5½ | 10 | 2,000 | 2,000 |
| 6 | 14 | 3,000 | 4,000 |
| 7 | 16 | 4,000 | 5,000 |
| 8 | 18 | 5,000 | 6,500 |
| 9 | 20 | 6,500 | 7,800 |
| 10 | — | 8,000 | — |
| 12 | — | 11,000 | — |

Some electrode holders are fairly reliable and efficient (without water cooling) where a reliable electrode economiser is fitted. The great difficulty is to find an economiser which will stand up in existing furnaces of the gallows-arm type fitted with amorphous carbon electrodes. The gallows arm comes down so close to the roof that a comparatively shallow economiser has to be employed.

Table IV.*

| K.V.A. | 220 | 450 | 650 | 765 | 750 | 1,200 | 1,800 | 2,500 | 3,000 |
|---|---|---|---|---|---|---|---|---|---|
| Size, tons | ¼ | 1½ | 3 | 2½ | 3 | 6 | 7 | 10 | 12 |
| Best month's output, tons | 96 | 180 | 266 | 287 | 279 | 453 | 492 | 537 | 791 |
| Units per ton | 768 | 770 | 626 | 720 | 817 | 647 | 677 | 945 | 869 |
| Heats per day | 2·6 | 6 | 3 | 4·8 | 4 | 3 | 2·4 | 2·3 | 3·6 |
| Electrode dia., in. | 4A | 5½G | 14A | 8G | 8G | 18A | 18A | 18A, 10G | 10G |
| Electrode consumption, lb. per ton in ladle | 17 | 21 | 47 | 12·6 | 13 | 30 | 100 | 30 | 12·9 |

* This table is a summary of the best results.
A = amorphous; G = graphite.

The problem is not so difficult with graphitic carbon electrodes. Self-adjusting economisers demand attention periodically, and are not sufficiently fool-proof. The author's view is that after the maker has done his best to improve an existing furnace by such an addition, it is up to the user to see that proper care and inspection of the same are practised. The whole question of "human element" is by far the most important in the operation of a reliable furnace.

Of the gallows-arm type of furnace the Snyder can claim over a period an electrode consumption as low as 7 lb. of 4-in. graphite per ton of steel in ladle. The Héroult, Greaves-Etchells, and Electro-Metals have with economisers each shown a graphite consumption over a period of 13 lb. per ton. Of the furnaces having no gallows arm the Stobie shows an electrode consumption of 9-in. graphite as low as 6·5 lb. per ton over a period of 5½ months.

Low-tension conductors have not received the necessary attention in the past. A current density of 750 amp. per sq. in. is ample for copper strip, for they are nearly sure to be run at a higher rate in actual practice. The maker should himself be responsible for all joints being properly made in the first instance, and should instruct the user to have them periodically inspected.

Transformers are the most important part of the furnace installation. Until recently, two transformer makers have had the bulk of the furnace business. Breakdowns of both makes have occurred due to the makers not appreciating the very heavy service their apparatus would be called upon to stand up to. Notwithstanding recent improvements breakdowns, though less frequent, happened owing to causes quite outside the transformer maker's control.

Automatic voltage and current regulators are going to help not only the transformers but also the power supplier. Woolwich Arsenal has a set running in conjunction with one of two 6-ton 2,000-K.V.A. Greaves-Etchells furnaces.

*(To be continued.)*

### Discussion in London.

Six papers were taken as read and discussed together.

Mr. Harbord opened the discussion by explaining that there were always two stages in the process, first melting the metal and then refining it. He was not competent to express an opinion as to which particular type of electric furnace was the best, that was a purely electrical question, but there was no difference from the metallurgical point of view. Unfortunately the induction furnace had not held its own, but he thought the problem to-day was still how to do away with the electrodes. Some steel makers used the Bessemer process for the first half of the process, and finished off by placing the molten metal in an electric furnace. In this way products equal to those produced by the open hearth method were obtained. In the speaker's opinion, some combination such as this would probably be found to be the best. With regard to melting ore in electric furnaces, not much progress had been made, and the output was small. Until very cheap power was obtainable electric blast furnaces could not compete with the ordinary furnaces, and he could not see any prospect of electric melting holding its own.

Mr. A. G. Ellis pointed out that the total output of electric steel in England had not been given. The current used in a furnace was limited by the size of the electrode, whereas in open-top carbide furnaces up to 40,000 amps. could be used. There was no limit to the size of transformers that could be built, even up to 50,000 amps. He was glad to see that emphasis had been laid on the necessity of making good jobs of transformer installations. He pleaded for simplicity, especially regarding connections and tappings; the latter should be brought right out of the transformer. In his opinion switchgear was much more likely to give trouble than transformers. Much of the trouble with the latter in the past had been due to short capacity. The right size of transformer had been arrived at mostly by trial and error methods with the result that transformers had not been made large enough. He did not think it was necessary to brace transformer coils in all directions, as it was quite a simple matter to determine in which direction coils would tend to move. Regulator tappings should always be brought outside the transformer so that it could continue working should the regulator break down. It was possible to obtain external regulation with 11,000 volts.

Mr. Campbell's remarks were chiefly confined to the production of ferro alloys. In 1918 the whole of the country's supplies of ferro chrome were produced electrically. Something like 10,000 tons were produced, and 80 millions of electrical units were used. The manufacture of tool steel had also been very large, and it was his opinion that electric steel equal in quality to crucible steel could be produced if equal care was taken in manufacturing. He thought that more attention should be given to electrical power contracts.

In Sheffield good work had been done, but no account was taken of power factor. It would be advantageous if a uniform method of charging could be adopted, this could consist of a fixed price plus power factor and coal clauses. With regard to the control of electric furnaces, it was possible to have a master controller that would regulate a number of furnaces on one feeder, so that the whole could be controlled from the power station.

Sir Robert A. Hadfield, F.R.S., congratulated the authors on the useful information that had been collected in the papers. The whole thing turned upon the cost of power; it was essential to have cheap power, and he hoped the national electricity supply scheme would have the desired result. This country would be in a very bad state indeed if that scheme did not give them really cheap power. In this country they were producing electric steel at a cost of between £2 and £3 per ton, whereas in Canada it was produced at 10s. per ton. Electric furnaces had been a very great help to his firm during the war, they had enabled them to make use of 100,000 tons of scrap metal which they would not otherwise have been able to utilise. He took that opportunity of thanking Mr. S. E. Fedden, manager and chief engineer of the Sheffield Corporation electricity undertaking, for his valuable help in getting the furnaces to work. The speaker's opinion was that electric furnaces had come to stop, but it was very desirable that they should have cheap power. In the U.S.A. they were using electricity not only for melting and refining metal, but also for annealing and such purposes; and it was therefore important to lower the cost of energy. A further point was that electrical heat was not the same as heat obtained from combustion; it was possible that electrical heat had some effect on the molecular structure of metals. It was claimed by one manufacturer that steel made in an ordinary furnace was improved by having an electric current passed through it while being cooled. He had examined samples of such steel, and although he had found no such superiority, that was no reason why the claims should be discredited.

Mr. W. M. Mordey said that reducing the cost of energy was not, in his opinion, necessary; it would serve a much more useful purpose if the amount of heat lost in the furnaces themselves could be reduced, and he thought a penalty should be imposed on steel makers for every unit wasted in this and other ways. These were matters beyond the electrical engineer; it was up to the user once he had got a good piece of apparatus to see that it was operated on the most economical lines. Another direction in which expenditure could be reduced was by exercising care with the electrodes. Much could be done to save energy by furnace inspection, and the application of common sense, for instance, by the use of Stobie electrode economisers. He thought that the secret of the great growth of electric furnaces during the war was to be found in the word swarf. The experience gained in this way was very valuable, and would lead to still more in the near future. In reply to those who depreciated the electric furnace, he would say that the tide had risen, and still continued to rise, in spite of all that was said against such furnaces. He would like to know whether the induction furnace was really dead. A paper setting out not its merits, but its defects, and the exact reasons why it had failed, would be very useful.

Mr. G. W. Partridge spoke as a supplier of electricity, and suggested that users of electric furnaces should exercise a little patience before they clamoured for cheap rates. He was of the opinion that if supply engineers were allowed reasonable time to make up for the lost time during the last few years in repairs and renewals, there was no reason why they should not supply energy at costs below ½d. per unit within the next three or four years. He thought that ½d. per unit was too low, but special rates for load factor were certainly desirable. After supplying power for railways, he thought electric furnaces would give them very little trouble, and an out of balance of 20 per cent. would make very little difference to an ordinary system. He was in entire agreement with the previous speaker as to the units consumed per ton produced. The importance of improving the consumption was shown by the statement that the consumptions of the same types of furnaces varied from 500 to as much as 5,000 units per ton of steel produced.

Mr. Payne said that the point that struck him was that of costs. The cost of steel in the ladle varied as much as 2½ times for exactly similar types of furnaces. In his opinion there was no great difference in types of furnaces or the consumption of different types, the whole thing was a question or management. His advice would be always to adopt automatic control, and, except for small furnaces, to use transformers which could be repaired on site.

A speaker said that electric furnaces had helped very greatly in Canada in dealing with large amounts of turnings and scrap metal. They had been able to make excellent steel from 100 per cent. turnings. With an installation of ten 6-ton furnaces they had been able to produce between 391-400 tons of steel per day at a consumption of between 550 to 750 units per ton. There was no economy in electrical apparatus unless it possessed a high factor of safety.

Another speaker said that some people attempted to run down electric furnaces, but it was significant that when a steel maker installed an electric furnace he very soon made enough money to install a second one, and always did so.

Major A. M. Taylor inquired whether single-phase furnaces were likely to go ahead in the future, and, if not, was it solely because supply engineers favoured the three-phase load? He suggested that if a single-phase E.M.F., of any frequency whatever, were superposed at the generating station on a three-phase feeder, a single-phase supply of that frequency could be drawn off any point on that feeder, and without materially unbalancing the supply on the three-phase mains. Existing three-phase transformers would be unaffected if the voltage wave were not too much deformed. On a 6,000-volt, three-phase system, if a single-phase E.M.F. of 1,500 volts were "injected" into each phase at the generating station, as much as 4,500 KW. of single-phase energy (roughly) could be passed over a feeder designed for 10,500 KW. three-phase, without deforming the E.M.F. wave sufficiently to injuriously affect existing transformers. As regards the cost of power, Major Taylor had given very close attention to this matter a few years ago in connection with the true "running cost" of energy put into large batteries (*i.e.*, the net out-of-pocket cost of the energy supplied at the time of no peak, and with such limitations as would avoid creating a peak), and he had found it to be of the order of ¼d. per unit at the generating station. This figure had, in his opinion, nearly sufficient margin to be allowed to stand, at present prices of coal, if generation was on a big enough scale. The cost of "fixed charges" on a 100 per cent. load factor, which might be obtained with proper relays of furnaces working all night and all day, would probably only add another ¼d. to ½d. He could not see why, even now, on a fairly large scale, energy could not be supplied between 11 p.m. and 7 a.m. at under ¼d. per unit, and the rest of the day at ½d. per unit. Electrical engineers went through all this sort of experience 15 years ago with the motor load, and offered prices in order to get that load, which neglected all their old capital investments and labour commitments, and assumed conditions which seemed almost "ideal"; but they got the motor load, after which they found certain unexpected things develop in their favour. Let them have similar enterprise now, and it might bring unexpected advantages in its wake. Everything depended on the load factor and the making of a 100 per cent. load factor was entirely in the hands of the furnace people themselves.

The authors of the papers reserved their replies to the discussion for publication in the *Journal* of the Institution.

## ALL-METAL PASSENGER CARS.

At the Institution of Civil Engineers on April 8th two papers were read on the construction and equipment of all-metal passenger cars for British railways, with special reference to those in use on the Manchester-Bury section of the L. & Y. Railway.

Mr. F. E. Gobey, O.B.E., dealt with the causes necessitating the change from timber to metal construction for the body of the car—the under-frame and bogie being already built of metal. Supplies of timber are now inadequate, while metal is readily available; Board of Trade recommendations with a view to reducing the effects of accidents support the change; timber cannot be made literally fireproof, though jarrah is practically non-inflammable, and has been successfully adopted for cable-troughing; and metallic construction, besides preventing fire, would render telescoping impossible. Very few wooden passenger-cars have been built in the United States in recent years. The only all-metal passenger cars constructed in Great Britain are those in use on the L. & Y. Railway, Manchester-Bury electric service; these have centre corridors with vestibule gangways and doorways at the ends, and are 63 ft. 7 in. long by 9 ft. 4 in. wide. The metal body is built directly on the under frame, and is designed as a weight-carrying structure. All the panels are of aluminium, the roof being single No. 14 S.W.G., and the sides below the windows double-cased with No. 14 and No. 18 S.W.G. The window-frames are of aluminium. The flooring is of galvanised iron No. 22 S.W.G. riveted to the under-frame and covered with composition.

In designing a metal car every detail has to be considered before issuing the drawings, as the various items have to be prepared in the machine shop before erection. The cars are built by the same staff as wooden cars. Owing to the necessity for interchangeability of parts, and the different tools employed, the work is very different from the building of wooden bodies. As regards weight, the all-metal electric motor-cars of the L. & Y. Railway, seating 74 passengers, weigh (unloaded) 120,960 lb., compared with 114,240 lb. for wooden cars seating 68, or 1,634 lb. per seat compared with 1,680 lb. The trailer cars are designed for conversion to motor-cars, if desired; deducting the additional weight (2,512 lb.) for this purpose, the comparison is 62,448 lb. for 95 passengers, or 643.7 lb. per passenger, as against 61,768 lb. for 97 passengers, or 636.7 lb. per seat.

The costs (excluding electrical equipment) show an increase of 5 to 8 per cent., *ceteris paribus*. Forty-six all-metal cars have been in service for three years, running 250,000 miles per car per annum. The under-frames and bodies have remained true and square, the materials have not corroded, and the cars are quiet in running. Three collisions have occurred, from which it appears that the

damage is limited to the ends of the cars, the doorways and vestibules bear the brunt of the shock, and there is no difficulty in effecting repairs.

Aluminium is preferable to steel for panelling and roofing, showing a return of 20 per cent. per annum due to saving in weight, and it requires less maintenance, being almost non-corrodible. After the car is built the steel work is sand-blasted *en bloc* to remove scale and rust and hold the paint, which is applied immediately afterwards; temporary bogies are used during this process. In the United States baking ovens holding a whole car are in use, temperatures ranging from 120 to 250 deg. F. being employed.

The author discusses designs of all-metal cars for main-line and suburban services, recommending the open type of car. The most economical length of car is 63½ ft., seating 103 passengers, and weighing 5 cwt. per seat (trailer car). The all-metal open car has many advantages over wooden compartment cars, in width, weight, comfort, paying load, maintenance, safety, &c. Metal compartment cars can be built in metal, but there are great advantages in combining the metal structure with the open-car design.

Appendixes show that the number of passenger cars in use on standard-gauge British railways in 1913 was 52,631, of which 1,019 were renewed in that year, at an average cost of £827.

In the United States there were in 1917 64,816 passenger cars, of which 17,601 were of steel; the latter are increasing at the rate of 1,885 per annum, while the number of wooden cars in service is decreasing at the rate of 1,541 per annum.

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In his paper on "The Electrical and Mechanical Equipment of the All-Metal Cars of the Manchester-Bury Section, L. and Y. Railway," Mr. George Hughes, M.Inst.C.E., gave a full account, with numerous illustrations, of the apparatus installed. The 1,200-volt current is collected from the live rail by shoes, which are directly connected with the main trolley-cable running along each side of the car. A rotary transformer supplies current at 100 volts for the operation of the contactors, pump-motor, lighting, and auxiliary apparatus, with the exception of the heaters, which are supplied direct from the trolley-cable and effectively protected by an earthed metal cover. The Aspinall side-contact live rail has been adopted. For the housing of the trolley-cable, after trying many substitutes for timber, it was found that nothing was so satisfactory as jarrah wood, which will not burn with a flame, and smothers an arc when one is formed. The high- and low-pressure couplers between the coaches were designed by Messrs. Dick, Kerr & Co., Ltd., who were contractors for part of the equipment.

All the 1,200-volt apparatus is housed in a high-pressure compartment with sheet-metal walls and door, the latter being interlocked with the main isolating switch, which can be opened only with the reversing-key of the controller. The rotary transformer is a compound-wound machine of 10 kw. capacity, with a double-wound two-commutator armature, and is attached to the under-frame of the motor-car. It is operated on the motor side by an automatic control-switch of the contactor type.

The control equipment is of the shunt multiple-unit contactor type, arranged so that automatic or manual operation may be used at will in the forward position, and manual only in the reverse. By preventing the driver from exceeding the normal acceleration current the maintenance of the motors and gearing is reduced; on the other hand, considerable attention is required to keep the relays and interlocking secondary contacts in an efficient working state.

There are two master-controllers on each motor and trailer car, each being only 8 inches wide, and weighing about 100 lb. There are nine positions of the controller-handle, and four of the reversing handle (manual and automatic ahead, off, and reverse). There are two main circuit-breakers on each car, which can be tripped or reset from the driver's compartment by 100-volt solenoids; there are also two groups of contactors on each motor-car, each group controlling two motors. Two motor cut-outs are provided, by means of which any motor can be cut out. The reversers, each of which controls two motors, are solenoid-operated.

The motor-bogie is built up on the lines of the best locomotive practice. The gear-wheels are pressed on the axle and bolted to flanges cast on the running-wheels; the latter are 3 ft. 7 in. in diameter, and have Siemens-Martin open-hearth steel tires. A 9-ft. wheel-base is used. Each bogie is equipped with two 200-h.p. motors, with a gear ratio of 2.36 :1. The gear-wheel and pinion are mild steel forgings, owing to pressure of work in the steel foundry; steel castings have given every satisfaction on the Liverpool and Southport line, having an average life of 250,000 miles. The teeth are of involute shape. Pressed-steel gear-cases have been found to give the best results. Half the weight of the motor is spring-borne.

The motors are of 200-h.p., on account of the heavier gradients in the neighbourhood of Manchester, and in order to maintain a high schedule speed; on the Southport line 150-h.p. motors were used. Other changes in design include the use of a solid field frame, improved ventilation, interpoles, the enclosure of the field and interpole coils in brass cases, larger bearings, and solid mica insulation for the armature coils. The field-coils are vacuum-impregnated, and are packed tightly into the brass boxes; experience shows that the cost of maintenance of brass-cased coils is negligible. For the field-frames the steel employed has the following composition: C, 0.11; Si, 0.32; S, 0.07; P, 0.06; Mn, 0.82; this has a permeability of 250 at a flux density of 17,000 lines per cm². The weight of the motor per h.p. is 36.92 lb. The tractive effort at 200 h.p., full field, is 2,850 lb., and the efficiency (through the gear) 88 per cent., the speed being 26 m.p.h. Vacuum brake gear is used, operated by motor-pumps, of 5 h.p.; the motors run at 1,000 r.p.m. on 100 volts, and are controlled by a two-contactor starter and an automatic regulator. If the driver releases the controller handle whilst running, the brakes are applied and current is cut off the main and pump motors.

Signal bells and emergency lighting are supplied with current from storage batteries, either six "Ironclad-Exide" cells or ten Edison cells, capable of discharging at 150 amps. for 5 hours. Each motor-car is lighted with 33 35-watt lamps at 100 volts, and heated by 20 heaters in series at 1,200 volts, taking 7 amps.

The equipment is inspected twice a week, and a weekly examination is made of the controlling gear, brushes, and commutators. Every six months a general overhaul takes place, the motors being taken out and the armatures removed, &c. Once a year the contactors and controlling gear are dismantled and put in order. This system has contributed to efficiency of service, the average total number of faults per month for the year ending July 31, 1918, being 72.4, and the faults per 1,000 motor-car miles 0.78. A record of faults is kept, and is analysed, so that any particular class of fault that develops can be watched and remedied. Curves showing the results of train tests with a dynamometer-car are given in the paper, and appendixes give details of construction of the motors, the weights of the cars and equipments, the method of testing the 1,200-volt motors with a supply pressure at 400 volts (a modification of the Kapp-Hopkinson test), and particulars of the train tests above-mentioned.

## NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

***Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.***

### Portable Welding Plant.

A new company, to be known as the A.C. Cutting and Welding Co., Ltd., is putting on the market for the first time in this country an electric arc welding plant which is a complete unit and portable, and takes its power supply from a.c. mains of any voltage or frequency. The outfit, which is made entirely in England, and protected by British patents, is furnished complete with welding handle, helmet, shield, switchboard, plugs, &c., and is ready to operate upon receipt.

As this machine can be made to operate equally well on

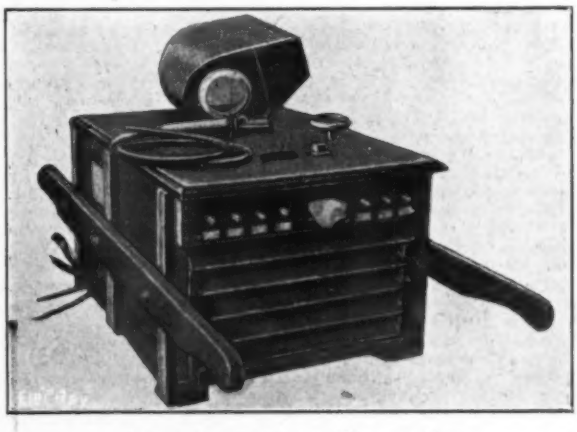

Fig. 1.—Portable a.c. Welding Set.

any frequency, the equipment is immediately adapted to the power supply, whether at 25, 50, or 100 cycles, without changing any of its characteristics. Its operation does not depend on reactance or inductance in any way; the design of the transformer is such that all requirements of the arc are met automatically in the design of the machine, without moving parts of any kind. The machine can be made to operate on any primary voltage, such as 220, 440, or 550. The apparatus can be connected in whatever way is most satisfactory to the power supply, thus reducing any possible disturbances in the circuit. Machines can be made which

will take power from more than one phase, although that is not commonly recommended. As the maximum demand for this machine is less than 5 KW. for welding, and less than 10 KW. for both cutting and welding, the unbalance of any one single-phase machine is negligible. The largest size weighs between 200 and 300 lb., and may therefore be carried about by two men without difficulty.

A well-designed transformer is naturally an efficient piece of apparatus, and the regulation used does not materially affect the efficiency, so that a very high electrical efficiency overall can be obtained. The makers claim a consumption of between 1 and 2 KW.-hr. per lb. of metal deposited. When the work is scattered and too large to be brought to the machine, the set can be wired from the high-pressure or primary side, whereas all other systems must be wired from the low-pressure or welding side, at a great disadvantage as to cost of copper and interference when welding. The only moving part is a self-contained cooling blower with ball bearings, requiring no oil. Constant watts mean a constant rate of heating, which is what is desired in welding; the current reduces with this machine just enough with the lengthening of the arc to supply practically constant watts to the arc. The amount of the watt input to the arc can be adjusted to the work and electrode by means of an easily moved shunt in the magnetic field circuit, together with voltage taps on the switchboard. The machine can be operated or left short-circuited continuously without undue temperature rise; in fact, the short-circuited primary power is less than the full-load KW.

Until the new company is incorporated all information regarding it and its products can be obtained from Mr. F. Farquhar, c/o American Supplies Co., Ltd., 162, Great Portland Street, London, W.

## NEW PATENTS APPLIED FOR, 1918.

### (NOT YET PUBLISHED.)

**Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 885, High Holborn, London, W.C. 1.**

10,453. "Safety device for securing terminal nuts on sparking plugs, accumulators, magnetos, &c." D. Benda, R. Freshwater, F. P. Houching and J. H. Pettinger. April 28th.

10,483. "Distributor or commutator for internal-combustion engines." P. W. Corless. April 28th.

10,484. "Safety locking-switch." P. W. Corless. April 28th.

10,490. "Treatment of zinc-bearing ores for recovery of zinc by electro-deposition." Electrolytic Zinc Co. April 28th. (Australia, April 27th, 1918.)

10,512, 10,514. "Magnetos for internal-combustion engines." C. F. Godwin. April 28th.

10,532. "Transmitters for wireless telephony." H. J. Round. April 28th.

10,533. "Electric generators." H. J. Round. April 28th.

10,543. "Timing gears for valve cams and magnetos for petrol engines." B. Poynton. April 29th.

10,550. "Ignition plugs for internal-combustion engines." F. Umpleby and R. D. Umpleby. April 29th.

10,579. "Electric light fittings." C. E. Hirst & C. T. O'Callaghan. April 29th.

10,603. "Electric apparatus for indicating and repeating movements at a distance." Schneider et Cie. April 29th.

10,606. "Protective devices for electrical distribution systems." British Thomson-Houston Co. (General Electric Co., U.S.A.) April 29th.

10,613. "Electric filament projection lamps." W. Williams. April 29th.

10,618. "Electrolytic cell, and method of operating same to produce oxides and powders of metals and alloys." A. E. White (Becker Bros.). April 29th.

10,628. "Signalling apparatus for aerial traffic." McKenzie, Holland and Westinghouse Power Signal Co. & L. H. Peter. April 29th.

10,644. "Electrical transmission disengaging lock switch." J. J. Wheatley. April 30th.

10,692. "Switches for electric bells." T. B. Sharp. April 30th.

10,698. "Thief-proof switch." R. W. Emerson. April 30th.

10,709, 10,710. "Telegraphy." B. Davies & Eastern Telegraph Co. April 30th.

10,716. "Manufacture of lead-covered electric cables." A. Olier & P. Roussillon. April 30th.

10,721. "Controlling supply of electric currents." J. Tavener. April 30th.

10,722, 10,723. "Manufacture of insulating, &c., compositions." F. J. Commin. April 30th.

10,725. "Electromagnets and apparatus employing same." International Electric Co. & H. E. R. Roose. April 30th.

10,737. "Means for supporting shade of electric incandescent lamp." L. G. Flory. April 30th.

10,755. "Manufacture of manganese and its alloys in electric furnaces." C. L. Lenoir. April 30th. (France, January 8th, 1914.)

10,769. "Insulators." British Thomson-Houston Co. (General Electric Co., U.S.A.) April 30th.

10,773. "Sparking plugs." A. Lyonnet. April 30th.

10,789. "Sparking plugs for internal-combustion engines." C. E. Tinson and G. N. Travers. April 30th.

10,844. "Sparking plug and terminal fitting." J. C. Roe. May 1st.

10,855. "Electric radiators." J. R. Quain. May 1st.

10,857. "Electrodes for electric welding." A. C. Hyde. May 1st.

10,795. "Electromagnets and apparatus employing same." International Electric Co. April 30th.

10,870. "Presses for assembling parts of sparking plugs." A. Lyonnet. May 1st.

10,877. "Magneto-electric machines." C. T. J. Opperman. May 1st.

10,878. "Sparking plugs." W. H. Norman & Southern Transport Co. May 1st.

10,881. "Primary electric batteries." Lithanode, Ltd., & A. N. Hazlehurst. May 1st.

10,910. "Microphones or electric transmitters for submarine signalling and reception of subaqueous vibrations." J. Gardner. May 2nd.

10,926. "Electric light, &c., lanterns." Cable Accessories Co. & F. H. Reeves. May 2nd.

10,932. "Apparatus for lamp signalling in overhead wire systems of electric traction." A. M. Willis & Brecknell, Munro & Rogers. May 2nd.

10,939. "Electric heaters." E. Delille. May 2nd. (France, September 25th, 1918.)

10,942. "Electric generators and motors." J. Shepherd. May 2nd.

10,943. "Vibration galvanometers, oscillographs, &c." F. O. Hunt. May 2nd.

10,975. "Arrangement for amplifying electric currents." M. D. Dimitrievitch. May 2nd.

10,986. "Transformation of polyphase currents in electric furnaces, &c." J. Birby. May 2nd.

11,000. "Apparatus for indicating failure of electric circuit." H. Jones. May 3rd.

11,008. "Process for coating wire, &c., with metals by electro-deposition." S. O. Cowper-Coles. May 3rd.

11,030. "Automatic cut-outs for electric circuits." W. A. Cocking & W. E. Hean. May 3rd.

11,032. "Electrical resistance and manufacture of same." G. Turnock. May 3rd.

11,038. "Thermo-telephone receivers." A. Williams & L. D. Williams. May 3rd.

11,086. "Method of indicating, locating, and/or isolating faults in electric transmission or distributing systems." Ateliers de Construction Oerlikon, P. Dawson, F. W. Fawdry, P. Luder & G. Wuthrich. May 3rd.

11,102. "Sparking plug." H. Wenger. May 3rd. (Switzerland, May 3rd, 1918.)

11,115. "Electric switches." G. Wightwick. May 3rd.

## PUBLISHED SPECIFICATIONS.

**The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.**

### 1916.

7,091. Electromagnetic sound receivers and producers. S. G. Brown. May 18th, 1916. (125,104.)

8,003. Underground electric circuit-making and breaking device. E. Brodsky. June 6th, 1916. (125,134.)

8,021. Synchronising of flash signalling apparatus. A. W. Sharman. June 6th, 1916. (125,135.)

8,259. Apparatus for manufacturing tubes of small diameter. S. O. Cowper-Coles. June 12th, 1916. (125,142.)

8,421. Optical signalling apparatus. A. W. Sharman. June 14th, 1916. (125,144.)

8,957. Electric control arrangements for the conversion of functions for use in connection with calculating apparatus, and for other purposes. H. R. Wright. June 26th, 1916. (125,165.)

### 1918.

3,726. Electric furnaces. J. Bibby. September 2nd, 1918. (125,179.)

3,925. Number dials for automatic and semi-automatic telephone systems. Automatic Telephone Manufacturing Co., Siemens Bros. & Co., Western Electric Co., G. W. Moore & J. E. Collyer. March 6th, 1918. (125,183.)

4,040. Ignition circuits of magnetos. Compagnie Generale de Magnetos. September 29th, 1917. (120,191.)

5,584. Telephonic attachment for phonographs and talking machines. H. Okell. April 2nd, 1918. (125,195.)

5,780. Electric lamp fittings. British Thomson-Houston Co. & H. C. Wheat. April 4th, 1918. (125,197.)

5,917. Vacuum electric discharge apparatus for lighting. British-Thomson-Houston Co. (General Electric Co., U.S.A.) April 6th, 1918. (125,201.)

5,970. Starting switches for alternating-current electric motors. British Thomson-Houston Co. & W. P. Hamlyn. April 8th, 1918. (125,206.)

6,138. Electrical switches. A. E. Read, J. E. Franks, M. Brooks & W. Compson. April 11th, 1918. (125,215.)

6,146. Electric signalling systems. H. Green. April 11th, 1918. (125,216.)

6,196. Systems of electric distribution having storage batteries, electrolytic cells, and the like. C. O. J. Montelius. March 24th, 1917. (115,623.)

6,222. Means for indicating in connection with the ignition circuits of the engines of aeroplanes. J. Roberts. April 12th, 1918. (125,223.)

6,256. Electric resistances. Brush Electrical Engineering Co. & C. C. Sutton. April 12th, 1918. (Addition to 1609/17.) (125,225.)

6,273. Electric lighting apparatus. Benjamin Electric, Ltd. April 19th, 1917. (115,630.)

6,599. Synchronous dynamo-electric machines. British Thomson-Houston Co. & R. D. Given. April 18th, 1918. (125,234.)

7,659. Electrical relays. S. G. Brown. May 7th, 1918. (125,252.)

7,727. Electric dry batteries. E. Armelin. May 8th, 1918. (125,254.)

7,745. Prizing or adjusting devices for electrical machines and turbines. Brush Electrical Engineering Co. (Aktiebolaget Ljungstroms Angturbin.) May 8th, 1918. (125,255.)

9,745. Electrical frequency meters. B. P. Romain. June 13th, 1918. (125,276.)

9,943. Electric circuit breakers. British Thomson-Houston Co. (General Electric Co., U.S.A.) June 17th, 1918. (125,279.)

15,060. Thermostats. C. E. Hearson. September 16th, 1918. (125,316.)

17,442. Electric fuse switches. Edison Swan Electric Co. & F. Shergold. October 25th, 1918. (125,325.)

18,716. Windings of the armatures of magneto machines. British Lighting & Ignition Co. & E. O. Turner. November 14th, 1918. (125,331.)

18,819. Electrical heating elements. G. Pate & N. C. Barrett. November 16th, 1918. (125,332.)

19,317. Electric time switch. Landis & Gyr Akt. Ges. December 18th, 1917. (121,594.)

21,311. Magnetos. Compagnie Generale de Magnetos. July 12th, 1918. (125,342.)

### 1919.

2,366. Electrical amusement apparatus. S. J. Levi. January 30th, 1919. (125,352.)

2,835. Rotary electric converters. British Westinghouse Electric and Manufacturing Co. March 13th, 1918. (124,193.)

**German Export Trade Plans.**—An Imperial Commissioner is to be appointed for the promotion of German export trade and for securing goods for sale abroad.—*Times.*

THE
# ELECTRICAL REVIEW.

VOL. LXXXIV. MAY 23, 1919. No. 2,165.

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## TO "ELECTRICAL REVIEW" READERS.

**We regret that recently a number of our readers have experienced difficulty in securing copies of The ELECTRICAL REVIEW. The reason for their disappointment is that our circulation is continuing to increase so rapidly that it is impossible for us to guarantee that any casual copies will be available after the hour of publication. In order to make sure of receiving one's copy regularly as issued, a definite order should be placed with a newsagent, or subscription should be sent direct to the Publishers, ELECTRICAL REVIEW, LTD., 4, Ludgate Hill, London, E.C. 4.**

## AN EXAMPLE OF INDUSTRIAL CO-OPERATION.

THE May number of *Unity* contains an article which is of unusual interest to all electrical engineers, inasmuch as it is a description of an experiment entered upon a couple of years ago by one of the largest electrical manufacturing concerns in the kingdom. The article is written by Mr. H. Mensforth, C.B.E., the well-known General Manager of Works of the British Westinghouse Electric and Manufacturing Co., Ltd.

It is evident, not only from Mr. Mensforth's article, but generally throughout industry, that there has been an increase of sympathy, and an appreciation of the need for co-operation, between the various groups of individuals engaged in industry. There is a tendency to realise the other fellow's difficulties, which brings about a desire to help things forward. We may accept at once the axiom with which Mr. Mensforth starts out—viz., "that the great majority of all classes of the population are both well-meaning and honest." It is a great thing to get people to believe in their own honesty, for if a man believes himself to be upright, he is less likely to do anything which will besmirch his record in his own eyes.

It is perhaps paradoxical, but it is true, that an increase of sympathy may initially manifest itself as an apparent increase in antagonism. The appreciation of a difficulty brings about a search for a method of overcoming it, and when this method is found, and appears to the finder to promise adequate solution of the problem, failure to apply it immediately is apt to produce great impatience, which may show itself in various ways of varying degrees of unpleasantness.

Mr. Mensforth "is looking forward to the time when, in the consideration of the undertaking or execution of a large contract, it will be possible to have representatives from the body of the workmen, who can be consulted in connection with these matters, and who are in a position to signify their willingness to take a certain amount of responsibility and interest in the proper execution thereof." He is, as this extract shows, very strong on the need for co-operation between the manual workers and the management, or direction; but what, in this connection, is the precise position of the administrative staff, which might with more aptness be called the management? Does Mr. Mensforth think it safe to rely on their constant sympathy with, and support of, the employers' interests? Who are "the representatives of the management" mentioned by him as members of the Works Committee? They are, of course, members of the staff, but they are not there to represent the views of the staff employés. Here, of course, we come right up against the outstanding defect in all such schemes, including the first Whitley Report itself. "Co-operation in

industry"—that is the magic word which is to bring about peace in the industrial world. But when the project is examined, it is found that two parties only are considered—viz., capital, or the employers, and organised bodies of workers, that is to say, the Trade Unions interested in each particular case. The article under discussion says that all members of the Committee, *of course* (our italics), with the exception of the management, are prominent Trade Unionists—none else can serve. We therefore have, on the one side, the Trade Unions, and on the other—not directors, not large shareholders, not bankers, but—members of the staff.

This state of things brings many dangers in its train. The workers' Trade Unions will naturally be suspicious of any attempt on the part of staff men to form Trade Unions for their own protection, for have they not always been brought face to face with these same men as the representatives of the employer class? This, we are sure, is the whole difficulty between the E.T.U. and the E.P.E.A., and various tactless statements on both sides have not tended to ease the situation.

On this subject much might, and, indeed, ought to, be written, for the purpose of clearing away the haze that obscures the situation, but further consideration must be reserved for another occasion.

While we believe that Mr. Mensforth has the root of the matter in him, and is, in general, proceeding on right lines, he none the less labours a few prevalent fallacies, to which we must take exception at once. The first is that the war has been a great teacher—for good, we suppose he means. The war has taught us nothing new that is good. Co-operation, brotherly love, mutual assistance, all of these were eternal verities before August, 1914. The war has taught men to make use of poison gas, of flame-throwers, and other means of wholesale slaughter, and these are new. Necessary, we admit, but wholly evil.

The second fallacy is that it is the war that has taught us that the average Briton can be led, but not driven, and the third is that the same teacher has brought out the value of proper team work. A moment's consideration of the thousand-year development of our Empire will show that, whatever may be new under the sun, these truths were truths from the beginning, and will remain truths for ever.

**The Danger of Bureaucracy.**

THE Government scheme for the reorganisation of electricity supply on a totally new basis, if it is carried out, will have many effects quite apart from those which are contemplated in the Bill, and some of these will be as unwelcome as they are unexpected. It is only when the car gets under way that the presence of sand in the bearings makes itself known and puts the brake on progress. The Electricity Supply Bill which is now before Parliament commends itself to us as, in the main, a sane and moderate measure by which great benefits should be conferred upon the industry and upon the public generally; but it is open to amendment, and now is the time to find out its weak points and to anticipate not only its direct results but also, if possible, those remoter and less obvious consequences against which safeguards should be provided.

One of these undesirable effects was recently brought to our notice by a well-known central-station engineer, who fears that the appointment of Electricity Commissioners and District Electricity Boards will inevitably bring with it a tendency towards that baneful effect which is invariably the offspring of bureaucratic control—namely, the repression of initiative and originality. It is a phenomenon which is by no means peculiar to State or municipal control, though it attains to its most luxuriant growth in the former; it is found also in any large industrial organisation of long standing, such as a great railway company or a huge manufacturing concern, and if it does not actually sprag the wheels, it certainly acts as a brake on progress.

Granted that there are honourable exceptions—that some big firms endeavour to encourage their staffs, from the chief to the office-boy, to put forward new ideas and to point out defects in current practice—even in such cases it is well-known that the disease can be only partially eradicated; there are always some officials who frown upon the presumption of their subordinates when the latter broach suggestions for improvements, and either suppress new ideas altogether as impracticable or because "we tried that long ago, and it wouldn't work," or seek to appropriate them for their own benefit.

Now, as our friend pointed out, the new scheme while subdivided territorially, will, nevertheless, constitute a single huge organisation extending from the Commissioners to the labourers, and after a time—when the spirit of bureaucracy has permeated the whole mass—it will become an offence for anyone but a highly-placed official to have any ideas of his own as to how things should be done; those who wish to retain the goodwill of their superiors will not disturb their equanimity by proposals of reform, no one will dare to communicate signed articles to the technical Press, and the subject of electricity supply will become a closed book to all who are outside the industry. As initiative will be restricted to the higher-placed officials, who are necessarily the older members of the profession, and, consequently, more cautious and less fertile of ideas than the juniors, technical progress will be slow and timorous. How often does a young railway official propound a new idea? If he does not mind his P's and Q's, he knows very well that he will be rewarded with the "sack." A similar spirit prevails in the Post Office, which has also taken the telephone industry under its wing, with consequences which are notorious.

How is this very real danger to be avoided? In his paper before the Society of Arts, of which we give an abstract elsewhere, Mr. J. S. Highfield points out the importance of providing a margin of profit to be applied to research, and this appears to offer unquestionable advantages; we would add that the policy should be adopted of providing facilities for every man engaged in the industry to have direct access to the controller of the research departments, with the certainty of appropriate reward in the event of his ideas being utilised. But even this leaves it open to the inventor's immediate superiors to vent their jealousy on him in one way or another for daring to be cleverer than themselves. It is a serious question, and we commend it to the notice of those who are piloting the Bill through Parliament.

**Conscience in a New Form.**

IN the course of a leading article in our issue of March 28th of this year, we commented on the fact that many American tramway undertakings were in great trouble because their revenue was insufficient to meet the enhanced expenditure arising out of war conditions. This state of affairs is, unfortunately, not confined to American tramway systems, but the majority of people are unable to increase their incomes by the direct means at the disposal of those concerns.

We remarked that it had been found that increasing the fares did not bring about a proportionate increase in the revenue, and it seems that there are more reasons than one for this disappointing result. If fares are too dear, passengers adopt other means of locomotion; but America, ever to the fore in introducing novelties, has developed a new type of conscientious objector. This product of the times takes his ride, but refuses to pay the fare, and we are told that in the one City of Columbus, Ohio, during the months of September and October, 1918, no fewer than three million passengers took this line of action.

This reveals a condition of fatuity which surely cannot be allowed to last. At the moment of writing we do not know what is the population of Columbus, but it is quite clear that these passengers do not consist of three million different persons. There must be a considerable amount of repetition joy-riding going on. Are one-man cars used? If so, it is questionable whether the economy thereby gained is commensurate with the loss that seems to be permitted.

We shall watch the American traction papers with interest for the solution of the difficulty.

# THE ELECTRICAL EQUIPMENT OF THE U.S.S. "NEW MEXICO."

The April issue of the *General Electric Review* is devoted almost wholly to an exhaustive account of the equipment of the U.S.S. *New Mexico*, the first battleship propelled by electric power. Three sister ships—the *California*, *Maryland*, and *West Virginia*—are being similarly equipped, and a number of 35-knot battle cruisers are under construction, each of which will have power plant six times more powerful than that of the *New Mexico*. The accompanying particulars and illustrations are derived from the journal above mentioned.

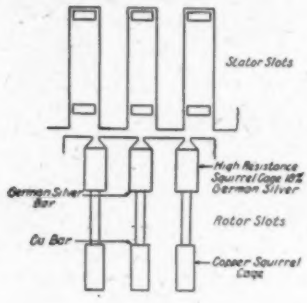



Fig. 1.—Section of Motor Slots.

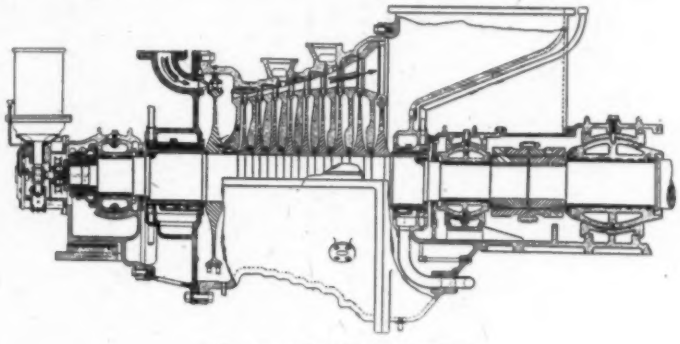


Fig. 2.—Section of Turbine.

The qualities which led the U.S. Navy Department to make this important departure from the usual practice were the great flexibility afforded by the electrical method of propulsion in the arrangement of the equipment, and the economy of fuel, which may amount to as much as 30 per cent. The reliability of the electric drive had already been demonstrated by the performance of the U.S.S. *Jupiter*, which had only been delayed once during the past five years by trouble with the electrical equipment, and then only for a few hours, repairs being effected by the ship's own staff. The complete independence of the propelling motors and the generators from one another is a most valuable feature in case of injury to any item of the plant, and the facility of reversal of the propellers without reversing the direction of rotation of the turbine or generator perfectly solves a difficult problem. There is no great difference between the electrical drive and geared turbines in respect of weight or space occupied; at full speed the latter have a slight advantage in economy, but at the lower speeds more generally required, the former is materially superior—especially in the case of battle-cruisers. As regards safety from torpedoes and gunfire, the electrical system has an enormous advantage over all other types of machinery, and greatly facilitates the designing of the ship to afford protection against such risks; here, in fact, is found the main reason for the adoption of electrical propulsion. Incidentally, the motors can be placed far aft, shortening the main shafting, the boilers can be grouped round the generators with short and direct steam piping, the various items of plant can be isolated in water-tight compartments, and the lay-out generally can be designed on the most convenient lines.

Turning to the installation on the *New Mexico*, it is interesting to observe that the design of the whole plant is dominated by the characteristics of the propellers, and that the solution of the problem has been found in the field excitation of the main generators, involving a wide departure from ordinary practice. While the continuous output of a turbo-generator is limited by heating, the maximum momentary output depends upon the excitation, varying approximately as the square of the field current; and assuming that the generator and motor are designed to work together under the most advantageous conditions, the maximum power of the motor thus depends upon the field excitation of the generator.

The motors on the *Jupiter* were of the slip-ring type, but for the *New Mexico* squirrel-cage motors of special design have been adopted. The rotor contains two squirrel cages, of high and low resistances respectively, and so inductively related that the high-resistance cage produces a

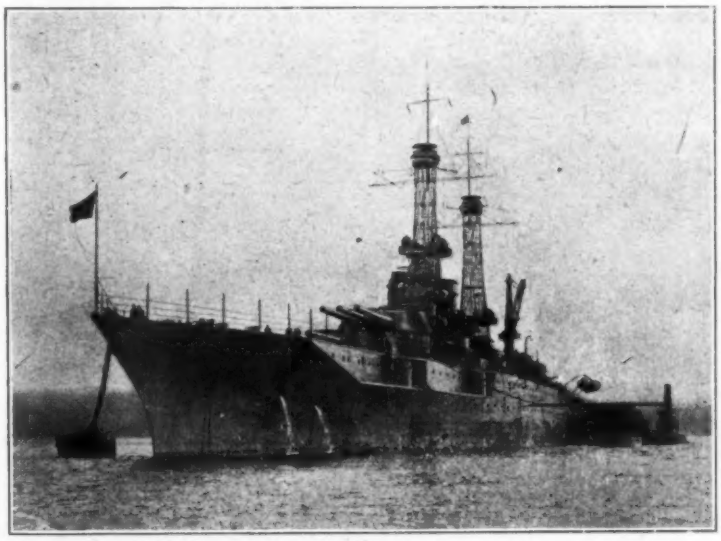


Fig. 3.—U.S.S. "New Mexico."
Tonnage, 32,000 tons; speed, 21 knots; power, 31,000 h.p.; armament, 12 14-in. guns in four turrets.

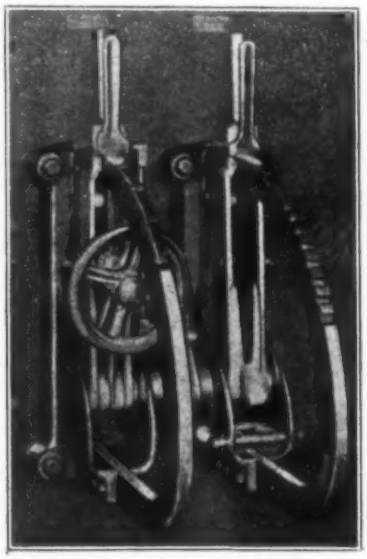


Fig. 4.—Steam and Field Control Levers.

high reversing torque, whilst the other provides a low-resistance path for the current at full speed. The characteristics of the motor are so co-ordinated with those of the propeller, together with the excitation of the generator, that a quick reversal of the propeller is ensured—a matter which is by no means so simple as it might appear. A section of the stator and rotor slots is given in fig. 1.

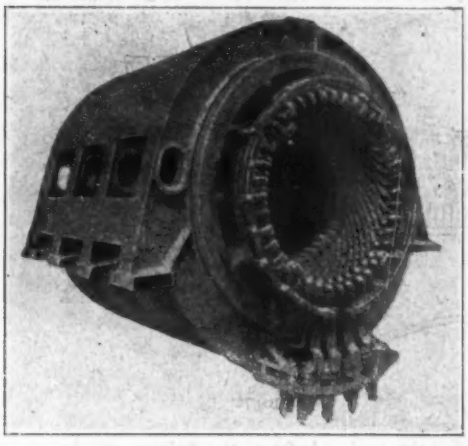


Fig. 5.—Stator of Generator.

The turbines are of the Curtis impulse type, with 10 admission valves to the first-stage nozzles, and 10 stages, and operate with steam at 250-lb. gauge pressure, superheated 50° F., and an absolute back pressure of 1·5 in. of mercury. A section of the turbine is given in fig. 2, which shows that it is axially very short, the over-all dimensions of the turbo-generator being 34 ft. 10 in. × 10 ft. 2 in. wide and 12 ft. high.

and generator base castings are replaced by a stiff structural steel foundation built into the ship's framework. A view of the stator is given in fig. 5.

The motors are wound with circuits giving 24 and 36 poles, according to the connections; with the former number the speed reduction is 12 : 1, and with the latter 18 : 1. To give intermediate speeds the speed of the generators is varied over a range from 1,440 to 2,100 r.p.m. (10 to 21 knots).

During the operation of reversal, which is always done on the 36-pole connection, at maximum speed, an excess excitation of 60 per cent. is applied to the generator field, and the line current rises to about three times the steady running value; the whole operation occupies 20 seconds, but the excess excitation is applied for only eight seconds. A very complete system of forced ventilation is provided for the generators and motors.

The winding of the motor stators is so designed as to give a balanced two-phase distribution for either 24 or 36 poles, with eight terminals. The rotor, as already explained, has two squirrel-cages, the end connections of which are seen in fig. 6.

The bars are driven into close-fitting slots without insulation, to allow the heat to flow freely into the rotor iron; the outer cage is of high-resistance metal, short-circuited by copper end-rings, into which the bars are brazed, these rings also being closely in contact with the rotor body. This is of importance during reversal, when the greatest amount of heat is generated in this winding, and the heat capacity of the rotor iron is thus utilised to keep the bars cool. The sections of the end-ring are joined together with expansion joints of laminated copper.

The inner cage is of copper bars electrically welded to a copper ring; as this winding remains cool under all conditions of running, no expansion joints are provided in it.

The complete motor is shown in fig. 8; it is rated at 6,700 h.p. at 4,000 volts on the 24-pole connection, and 2,050 h.p. at 2,800 volts on the 36-pole connection, with an overload capacity of 8,375 h.p. at 173 r.p.m. At speeds

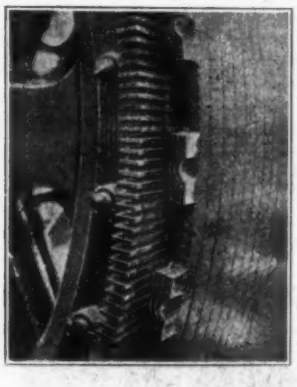


Fig. 6.—Detail of Rotor Winding.

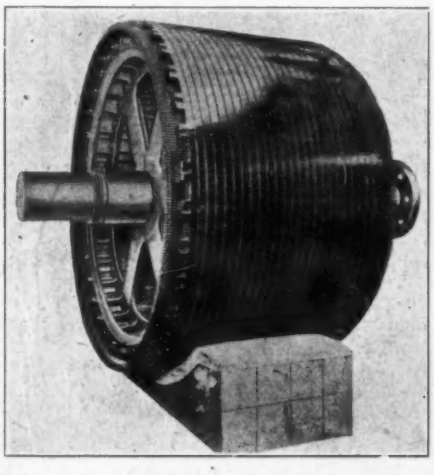


Fig. 7.—Rotor of Induction Motor with Double Squirrel-cage.

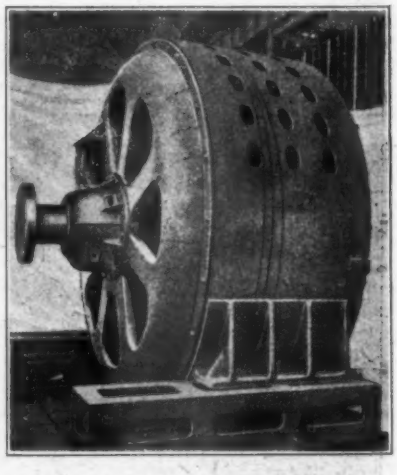


Fig. 8.—Complete Motor.

The generators, rated at 10,500 k.v.a., at 78 per cent. power factor, and 13,500 k.v.a. at the full speed of the ship, operate at a maximum frequency of 35 cycles per second, 2,100 r.p.m.; they have an overload capacity of 25 per cent. (16,850 k.v.a., at 78 per cent. power factor), for four hours. The stators are wound two-phase, and the circuits can be connected in two ways, giving 3,000 and 4,240 volts respectively. All speeds up to 17 knots are obtained by the use of one generator with the low-voltage connection, feeding the four motors; for higher speeds both generators are used, with the high-voltage connection, each feeding two motors. The efficiency at a load and speed corresponding to 10 knots is 95 per cent., and at 21·5 knots 97 per cent. The generators are in general of similar design to land machines, except that the turbine

from 8 to 15 knots the four motors are operated on the 36-pole connection from one generator; from 15 to 17 knots, the same on the 24-pole connection; above 17 knots, two generators are used, each separately feeding two motors (the generators are prevented by interlocking gear from ever being put in parallel). The control gear is in itself an elaborate equipment, being provided with a great variety of interlocks to prevent wrong connections, and is described as the most intricate and important part of the equipment.

Two 300-kw. turbine-gear-driven exciting sets are provided, generating at either 120 or 240 volts, and two motor-driven boosters, one for each generator field, which can raise or lower the voltage by 60 volts. The main cables have a fibre core, pure rubber insulation, and a covering of asbestos braid filled with fire-resisting paint,

and are protected with sheet-iron covers. The cables carrying direct current are insulated with pure rubber, lead-covered, and armoured with galvanised steel wire.

In addition to the propelling equipment, a complete outfit of electrically-driven auxiliaries is provided, embracing circulating, air, and hot-well pumps in duplicate, four lubricating-oil pumps, oil coolers, and blowers for ventilating the main motors. The total weight of the complete plant, with spare parts, was guaranteed not to exceed 700

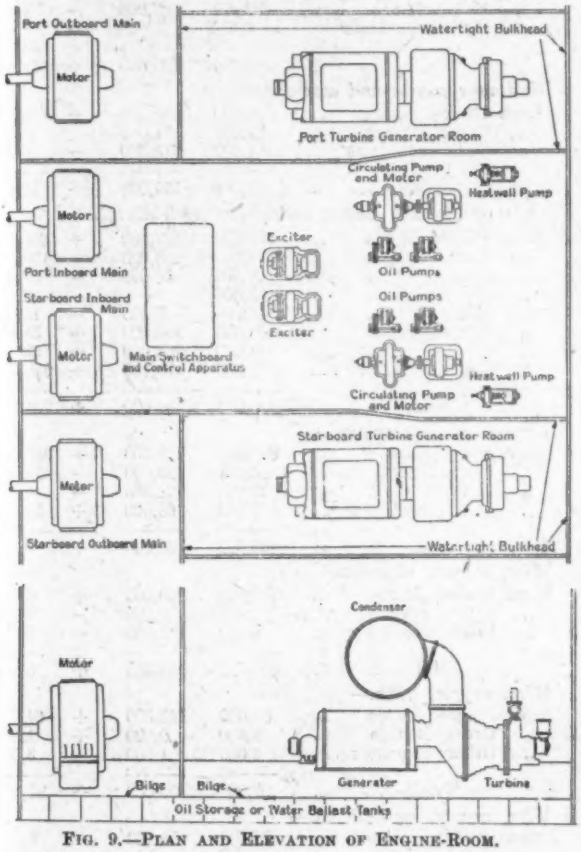



FIG. 9.—PLAN AND ELEVATION OF ENGINE-ROOM.

tons; the actual weight was 590 tons. The steam consumption was guaranteed not to exceed the following figures with dry saturated steam at 250 lb. per sq. in. (gauge), including the auxiliaries:—At 10 knots, 15·38 lb. per shaft H.P.-hour; at 15 knots, 11·57 lb.; at 19 knots, 11·32 lb.; at 21 knots, 11·53 lb. Heavy penalties were attached to these guarantees.

The contract price for the complete plant was $431,000.

Gunfire tests were carried out, including the discharge of all the 12 14-in. guns at the same instant, but no effect was observed on the electrical equipment or the turbines.

The official trials of the equipment were carried out on December 16th-18th, 1918. Owing to overloading which increased the displacement by 1,000 tons, the power required to drive the ship was greater than was anticipated, amounting to 31,000 H.P. at 21·25 knots, at which speed a four-hour trial was run. The results were regarded as highly satisfactory. As the normal conditions did not obtain, the steam consumption was somewhat above the guarantees at the higher speeds.

**A.C. Arc Welding.**—The advantages of A.C. compared with D.C. for metallic arc welding are pointed out in the *Electrical World* with considerable bias in favour of the A.C. system. It is claimed that the efficiency of A.C. welding is higher (1 lb. of metal being deposited for less than 2 KW.-hours). It is said that the power factor ranges from 35 to 65 per cent. in welding, and from 65 to 90 per cent. in cutting. Finally, it is pointed out that the user pays for KW.-hours regardless of power factor. This is still the case in most supply areas, but the evil effects of low power factor are becoming generally appreciated, and it is probable that tariffs penalising low power factor will become common.

## WAGE SYSTEMS IN RELATION TO EFFICIENCY.

BY MAJOR E. A. PELLS, R.E.

GOOD work claims good wages, and it is obvious that it can profit no one if the value of the work done is less than the payment received by the worker. Many and varied are the methods that have been evolved from time to time by employers to get the best from their employés and yet to give them an equitable reward. Whatever the system of pay may be, it is laid down in a special clause in the Factory Act (S. 116, F. and W. Act, 1901) that all workers must be supplied with a clear explanation of the wage system under which they are paid. It is also to the advantage of the employer to do this, as nothing causes dissatisfaction quicker than for the workers to get the impression that they are being swindled in some way. To procure a proper day's work, the reward in pay must be sufficient to make the operative work willingly and to enable him to live well and comfortably, so that his efficiency is not impaired by ill-health. The method of payment that is most common is payment by time, and this has been considered satisfactory from the point of view of many, and has in some cases, with suitable environment and good faith on the part of employers and employés, given very good results. But one cannot get away from the remarkable fact that actual results in certain munition works showed a 24 per cent. increase on day shift, and 40 per cent. on night shift, in output on the introduction of piece rates.

The piece-rate method of pay is much more satisfactory to the employer and the industrious employé, but is viewed with disfavour by the "weaker brother." It is usually in the fixing of piece rates that the employer and worker find themselves at loggerheads, and it is in this direction that Trade Unions could prove useful by appointing members on a combined committee of employers and employés to fix the piece rates for their particular industry. If this were done, it could not but work satisfactorily, as the rates would hold good throughout the trade, and there would not be the undercutting which has been one of the greatest curses in the industrial world.

The whole of the blame for cutting rates should not be placed on the employer, for he has often been tempted by the worker to do that which he had originally not the slightest idea of doing. Rates fixed by a combined committee would be far more likely to be quite equitable, and therefore more satisfactory, to the whole industry concerned.

However, although piece-rate methods of pay commend themselves as being payment for value received, yet there are several objections to them. Where accuracy is very important there is always the danger of scamped work, and it is only by careful inspection that quality can be ensured as well as quantity. Another drawback is that they do not give you a method of reward by which you can get the best out of your employés. In other words, they encourage the wrong workers. What is needed is a system of wages which has the effect of especially encouraging the weaker workers, yet without discouraging those who are in "championship form."

The Gantt bonus system comes into this category, and is, therefore, in my opinion the best. It is easily explained and understood, being perfectly straightforward, and is therefore best from the point of view of efficiency. All workers completing their task in the working day receive a bonus and also a piece rate for all work over. Any worker who does not complete the task still receives the regular time rate for that kind of work, so that the weaker worker is not completely discouraged; but with the assistance of the special foremen detailed to instruct, he will very soon succeed in completing the task satisfactorily in the time allowed, which is usually about 160 per cent. of the standard. The Towne Halsey premium-bonus system is similar in general idea, the difference being that the work done beyond the task is not paid for by piece rates, but by a correctly calculated and scheduled bonus increasing in direct ratio to the output.

The criticism levelled at these systems by the exponents of the Rowan premium-bonus system is that they are not correct scientifically, and the principal advantage they put forward on behalf of the Rowan system is that being calculated scientifically it protects the worker from himself, as up to 150 per cent. efficiency the bonus is an increasing amount, but past this point it is a dropping curve. My objection to this system is the difficulty often experienced in explaining to the worker the reason for the payment getting smaller again. In works where standards have been very successfully fixed, and very few workers reach 150 per cent. efficiency and none ever exceed it, this objection does not arise, and the introduction of this method of payment has given very good results.

Profit-sharing is a very beautiful idea, but the reward is usually such a long time deferred that it very often misses its object completely as an encouragement to increased output. This especially applies among the lower-grade workers.

Some employers have given bonuses for good time-keeping, but good time-keeping does not necessarily mean good and efficient work. The question of the best wage system for the character of work and type of worker is a matter for careful study; whatever system is used, the study of wages paid, increases, &c., is very useful, and enables the management to investigate any apparent limitation of output. In all questions of wages the principal thing to keep in view is the effect of a "square deal," and the whole question revolves on general social, economic, and hygienic considerations.

## TRADE STATISTICS OF BRAZIL.

The following figures show the imports into Brazil of electrical and similar goods during the year 1917. The figures for 1916 have been added for purposes of comparison, and notes of increases or decreases, as the case may be, are given:—

| | Dollars. 1916. | Dollars. 1917. | Dollars. Inc. or dec. |
|---|---|---|---|
| *Dynamos and electrical generators.—* | | | |
| From United States ... | 43,500 | 36,000 | – 7,500 |
| ,, Great Britain ... | 7,000 | — | – 7,000 |
| ,, Switzerland ... | 26,000 | 55,000 | + 29,000 |
| ,, Other countries ... | 6,500 | 16,000 | + 9,500 |
| Total ... ... | 83,000 | 107,000 | + 24,000 |
| *Electric motors.—* | | | |
| From United States ... | 42,000 | 100,000 | + 58,000 |
| ,, Great Britain ... | 28,000 | 18,000 | – 10,000 |
| ,, Switzerland ... | 40,000 | 29,000 | – 11,000 |
| ,, Other countries ... | 13,000 | 21,000 | + 8,000 |
| Total ... ... | 123,000 | 168,000 | + 45,000 |
| *Transformers.—* | | | |
| From United States ... | 131,000 | 91,000 | – 40,000 |
| ,, Great Britain ... | 14,000 | 4,000 | – 10,000 |
| ,, Other countries ... | 7,000 | 12,000 | + 5,000 |
| Total ... ... | 152,000 | 107,000 | – 45,000 |
| *Other electrical machinery.—* | | | |
| From United States ... | 876,000 | 1,349,000 | + 473,000 |
| ,, Great Britain ... | 128,000 | 129,000 | + 1,000 |
| ,, France ... ... | 37,000 | 24,000 | – 13,000 |
| ,, Other countries ... | 85,000 | 92,000 | + 7,000 |
| Total ... ... | 1,126,000 | 1,594,000 | + 468,000 |
| *Steam engines.—* | | | |
| From United States ... | 2,000 | 1,000 | – 1,000 |
| ,, Great Britain ... | 11,000 | 1,000 | – 10,000 |
| ,, Other countries ... | 4,000 | 3,000 | – 1,000 |
| Total ... ... | 17,000 | 5,000 | – 12,000 |
| *Industrial machinery.—* | | | |
| From United States ... | 288,000 | 488,000 | + 200,000 |
| ,, Great Britain ... | 315,000 | 229,000 | – 86,000 |
| ,, France ... ... | 54,000 | 84,000 | + 30,000 |
| ,, Other countries ... | 101,000* | 51,000† | – 50,000 |
| Total ... ... | 758,000 | 852,000 | + 94,000 |
| *Motors, gasoline, kerosene, &c.—* | | | |
| From United States ... | 41,000 | 29,000 | – 12,000 |
| ,, Great Britain ... | 8,000 | 6,000 | – 2,000 |
| ,, Switzerland ... | 15,000 | 44,000 | + 29,000 |
| ,, Other countries ... | 150,000 | 7,000 | – 143,000 |
| Total ... ... | 214,000 | 86,000 | – 128,000 |
| *Motors, n.o.e.—* | | | |
| From United States ... | 40,000 | 64,000 | + 24,000 |
| ,, Great Britain ... | 16,000 | 10,000 | – 6,000 |
| ,, Sweden ... ... | 19,000 | — | – 19,000 |
| ,, Switzerland ... | 32,000 | 36,000 | + 4,000 |
| ,, Other countries ... | 4,000 | 10,000 | + 6,000 |
| Total ... ... | 111,000 | 120,000 | + 19,000 |
| *Hydraulic pumps and accessories.—* | | | |
| From United States ... | 56,000 | 76,000 | + 20,000 |
| ,, Great Britain ... | 11,000 | 11,000 | — |
| ,, Other countries ... | 24,000 | 18,000 | – 6,000 |
| Total ... ... | 91,000 | 105,000 | + 14,000 |
| *Other machinery (except textile and agricultural).—* | | | |
| From United States ... | 936,000 | 1,597,000 | + 661,000 |
| ,, Great Britain ... | 331,000 | 223,000 | – 108,000 |
| ,, France ... ... | 97,000 | 38,000 | – 59,000 |
| ,, Belgium ... ... | 3,000 | — | – 3,000 |
| ,, Italy ... ... | 21,000 | 6,000 | – 15,000 |
| ,, Switzerland ... | 82,000 | 136,000 | + 54,000 |
| ,, Sweden ... ... | 55,000 | 108,000 | + 53,000 |
| ,, Other countries ... | 77,000 | 198,000 | + 121,000 |
| Total ... ... | 1,602,000 | 2,306,000 | + 704,000 |
| *Electric wire or cable.—* | | | |
| From United States ... | 381,000 | 722,000 | + 341,000 |
| ,, Great Britain ... | 34,000 | 19,000 | – 15,000 |
| ,, Italy ... ... | 25,000 | 21,000 | – 4,000 |
| ,, Other countries ... | 9,000 | 68,000 | + 59,000 |
| Total ... ... | 449,000 | 830,000 | + 381,000 |
| *Wire, copper, electrical.—* | | | |
| From United States ... | 342,000 | 346,000 | + 4,000 |
| ,, Great Britain ... | 9,000 | 2,000 | – 7,000 |
| ,, Other countries ... | 5,000 | 13,000 | + 8,000 |
| Total ... ... | 365,000 | 361,000 | + 5,000 |
| *Wirs, copper, n.o.e.—* | | | |
| From United States ... | 85,000 | 149,000 | + 64,000 |
| ,, Great Britain ... | 8,000 | 9,000 | + 1,000 |
| ,, Other countries ... | 4,000 | 1,000 | – 3,000 |
| Total ... ... | 97,000 | 159,000 | + 62,000 |
| *Wire, copper, uninsulated.—* | | | |
| From United States ... | 27,000 | 19,000 | – 8,000 |
| ,, Great Britain ... | 2,000 | — | – 2,000 |
| ,, Other countries ... | 1,000 | — | – 1,000 |
| Total ... ... | 30,000 | 19,000 | – 11,000 |
| *Telegraph and telephone posts, and bridge and fence material.—* | | | |
| From United States ... | 52,000 | 59,000 | + 7,000 |
| ,, Great Britain ... | 73,000 | 1,000 | – 72,000 |
| Total ... ... | 125,000 | 60,000 | – 65,000 |
| *Insulators.—* | | | |
| From United States ... | 53,000 | 71,000 | + 18,000 |
| ,, Great Britain ... | 17,000 | 27,000 | + 10,000 |
| ,, Other countries ... | 5,000 | 4,000 | – 1,000 |
| Total ... ... | 75,000 | 102,000 | + 27,000 |
| *Electric lamps.—* | | | |
| From United States ... | 237,000 | 370,000 | + 133,000 |
| ,, Great Britain ... | 14,000 | 17,000 | + 3,000 |
| ,, Holland ... ... | 40,000 | 55,000 | + 15,000 |
| ,, Other countries ... | 21,000 | 13,000 | – 8,000 |
| Total ... ... | 312,000 | 455,000 | + 143,000 |
| *Scientific instruments.—* | | | |
| From United States ... | 48,000 | 64,000 | + 16,000 |
| ,, France ... ... | 20,000 | 10,000 | – 10,000 |
| ,, Great Britain ... | 20,000 | 14,000 | – 6,000 |
| ,, Other countries ... | 12,000 | 18,000 | + 6,000 |
| Total ... ... | 100,000 | 106,000 | + 6,000 |

* Sweden, $35,000. † Italy, $5,000.

**Denmark-Sweden Tunnel.**—The proposed tunnel to connect Denmark and Sweden will start on the eastern side of the Amagar Island, says the *Engineer*. Construction will, however, be commenced by sinking shafts on the island of Saltholm. The tunnel will be 11 miles long, and the total length of the railway will be 31½ miles.

## ELECTRIC FURNACE PRACTICE.

(*Continued from page* 581.)

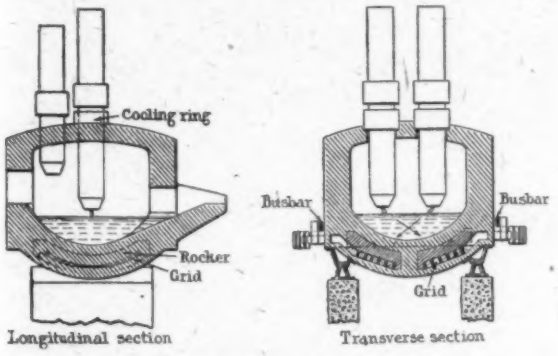
### The Booth-Hall Electric Furnace.

BY W. K. BOOTH.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

It is the purpose here to describe a new type of electric furnace which has been developed during the last year, and which is known as the Booth-Hall electric furnace. It comes under the conducting-hearth, vertical-arc class, and is illustrated diagrammatically in figs. 1 to 4.

Fig. 1 is a longitudinal sections of the two-phase electric furnace with the auxiliary electrode resting upon the charge and arcs drawn between the main electrodes and the charge. A pool of metal is shown forming on the hearth of the furnace.




FIGS. 1 & 2.—BOOTH-HALL TWO-PHASE FURNACE.

Fig. 2 is a transverse section of the two-phase electric furnace, showing the crossing action of the current in the bath and the grids embedded in the hearth.

Fig. 3 shows the electrical connections for the two-phase electric furnace employing two single-phase Scott-connected transformers. This diagram shows the connections from the transformer terminals to the main electrodes and to the auxiliary electrode and grids. A two-phase electric furnace so connected gives a balanced load on a three-phase power service. The auxiliary electrode is shown in black.

Fig. 4 shows the arrangement of main and auxiliary electrodes in singe-, two-, and three-phase furnaces. The auxiliary electrodes are shown in black.

The general principle is a furnace having a solid hearth which becomes conductive of electricity when hot, and the use of an auxiliary electrode which acts as a return for the electric current until the hearth becomes heated and conductive. In starting on a cold charge the auxiliary electrode is lowered until it rests on top of the charge, and the arc is then drawn between the charge and the main electrodes, the auxiliary acting as a return. The auxiliary is so arranged that it presses with its entire weight on top of the charge, and consequently no arc can form underneath the auxiliary; experience has demonstrated that no arc does form. The auxiliary is connected in parallel with the conducting hearth, and when the main electrodes have melted enough metal to

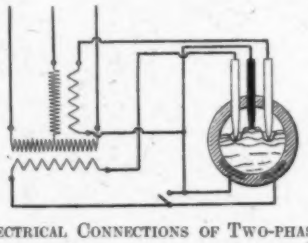


FIG. 3.—ELECTRICAL CONNECTIONS OF TWO-PHASE FURNACE.

form a pool on the bottom the hearth becomes conductive and the auxiliary is withdrawn from contact with the charge. In a cold furnace the auxiliary is in operation from 30 to 45 minutes, and in a furnace which is hot less than 15 minutes; only long enough to assure a positive start and a balanced load on the line.

Furnaces from ½ to 6 tons' holding capacity are generally built for two-phase operation, taking power from three-phase service by means of Scott-connected transformers, as shown in fig. 3. In the hearth of the two-phase electric furnace two sets of grids are embedded, which are electrically insulated from each other, and are so related to the main electrodes that the currents of the two phases cross in the bath, thus giving a maximum of circulation of the molten metal and causing, in conjunction with the effect of the bottom heating, a very thorough mixing of the metal in the bath. The conducting grids are placed as far as possible from the heated interior of the furnace, and experience has shown that they never become overheated or require special cooling. The grids are so constructed as to handle large currents, furnishing large areas of contact with the material of the conducting bottom, and preventing local heating due to contact resistance.

By the use of the auxiliary electrode a positive start of the furnace is guaranteed, and there is no possibility of failure to secure contact. Each main electrode is independent of the other, as there are no arcs in series, and consequently the regulation of the furnace is very simple, giving a balanced polyphase load on the power service lines. As with the two-phase connection there are only two electrodes to regulate, this offers the minimum number of electrodes for a balanced polyphase load, and the smaller the number of electrodes requiring regulation the smoother becomes the furnace operation.

FIG. 4.—SINGLE-, TWO-, AND THREE-PHASE ELECTRODE ARRANGEMENT.

The hearth is either acid or basic, as desired, and in each case is at least 24 in. (60 cm.) in thickness, being sintered in place layer by layer and forming a monolithic mass. By using the main electrodes in conjunction with the auxiliary, the materials of the hearth are sintered together in thin layers similar to open-hearth practice, thus forming a very durable bottom and making the danger of run-outs a minimum. The furnace hearth is consequently solid, with no water cooling of any kind. With the basic hearth, dead burned dolomite is used to maintain the slag line; in the acid furnace, ground ganister is used for the same purpose. The conducting hearth gives a uniform bottom heating of the entire bath, prevents sculls, and makes speedier and more thorough distribution of the heavier alloys, which tend to sink to the bottom of the bath. The effect of this bottom heating is considerable.

With the two-phase electric furnace a minimum of electrode consumption is secured. The loss on the auxiliary electrode is small. The electrode jaws are made to grip or release by turning a handwheel at the side of the furnace. The jaws are arranged in segments so as to adjust themselves to the inaccuracies in the surface of the electrodes. A roomy charging door of special construction is provided in the rear of the furnace, and another door in front over the tap. This construction permits a battery of furnaces to be arranged side by side and a charging machine to serve them all. The furnace tilts or rocks backward as well as forward, and slagging operations can be handled from either the rear or the front as desired.

The furnace is motor tilted, in all sizes, for pouring, but can be tilted by hand in emergency. The smaller sizes of furnace are built for hand operation only, if desired. All parts of the tilting mechanism, including gears and motors, are arranged so that they do not come beneath the furnace, and therefore there is nothing under the furnace that can be injured in case of a run-out.

The main electrodes are automatically regulated, and also, in every case, they can be regulated by hand. The power input can be maintained at any point from one-fourth to full load by means of voltage reduction and control switches.

In making steel for the ordinary grade of steel castings, the Booth-Hall electric furnace has operated with a power consumption as low as 446 KW.-hr. per 2,000 lb. (906 kg.) of steel poured, but the average will be between 500 and 550 KW.-hr. per net ton for continuous operation. In one 4-ton furnace a considerable quantity of low phosphorous pig-iron has been made, running over 0.035 per cent. in phosphorous and sulphur, also special steels requiring refining with two or more slags.

### A New Type of Electric Furnace.

BY AXEL SAHLIN.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE furnace which is the subject of this paper has been designed with a view to embodying the advantages of both the direct-arc and the free-burning-arc furnaces, at the same time avoiding as far as possible the disadvantages of both.

The furnace is built as a circular ladle with contracted top and dished bottom. The shell plates are perforated by drilled holes, spaced about 12 in. apart and serving as vents for moisture contained in the lining. The steel casting trunnions are riveted to the shell, and rest in bearings set so as to allow

for expansion and alignment. To the overhanging end of one trunnion is keyed a crank which, by means of an enclosed screw, running in oil, working in a swivelled crosshead and turned by handwheel (or motor) serves to tilt the furnace. The bottom of the furnace is made up of a layer of coke dust and tar rammed in, supporting double layers of brick. On top of this is rammed and fixed in successive layers a hearth consisting of burnt dolomite and tar for basic operation, or of ganister in case the acid process is adopted. Supported and resting on the firebrick, outside the hearth, is placed a circular lining backed by a heavy insulating layer of asbestos sheet and formed of circle-bricks laid with ground joints and thin morfar. This lining may be made of magnesite brick for basic process, or of silica brick for acid process. In the lining are placed on the same vertical lines two holes for each pair of electrodes, and one door opening which serves both to charge the furnace and to pour the steel. On top of the contracted top of the side lining rests the dome-shaped roof built of basic or acid brick fitted in a circular steel frame, forming a rigid skewback. The roof joint is made of a layer of powdered dolomite or ganister spread on top of the side wall. The roof can be removed by crane without delay, and replaced by another preheated roof held in readiness. It is also possible to charge the furnace through the top by removing the roof while the charge is put in place.

The electrodes, graphite or carbon of cylindrical form, are extended as they are burnt away by screwing a new section of electrode to the rear end of the electrode in operation. The joint is made by threaded dowls of graphite. The electrodes slide through water-cooled electrode holders. The electrodes are wrapped in sheets of asbestos, mica, or fibre, and are thus insulated from the furnace body. The electrode cooler with its insulation is placed between the fixed upper and sliding lower jaws of a clamp which is pivoted to a frame bolted to the furnace shell. Both halves of the grips are water-cooled. Both grips are made with an extending wing, to which is bolted the bronze cable socket. Both the swivelled guides are adjusted in a vertical sense, controlling at will the inclination of the electrodes.

The number of electrodes proposed is for a furnace hearth up to 3 ft. 6 in. dia., 1 pair; from 3 ft. 6 in. to 5 ft. dia., 2 pairs; from 5 ft. to 7 ft. dia., 3 pairs; from 7 ft. to 9 ft. dia., 4 pairs; from 9 ft. to 11 ft. dia., 6 pairs.

The electrodes should be preferably of graphite, varying from 2 to 6 in. dia. Each pair of electrodes enters the furnace in the same vertical plane, but at different and adjustable angles. The upper electrodes are supplied with current. The lower electrodes, as well as the furnace body (and, if the furnace is going to be used largely for refining work, a bottom electrode bedded in the hearth) are connected with the common of the transformer, or earthed. For a one-pair furnace, D.C. or one-phase A.C. is used. For a two-pair furnace it is preferable to employ two-phase current, generally obtained by three-phase transformers arranged in Scott's coupling. For a three-pair furnace, three-phase current is used, one phase being coupled to each upper electrode.

For furnaces with more than three pairs of electrodes, groups of two pairs are coupled in parallel; therefore, a four-pair electrode furnace uses two-phase current, whereas a six-pair furnace should be supplied with three-phase current. If for any reason it may be found desirable, the upper electrodes can be earthed, and the current can be supplied through the lower electrodes. A bottom electrode bedded in the hearth may be used or not; it is useful when refining.

The pressure of the supply should preferably be transformed to 100 volts which, by plugs on the transformer, may be reduced at option to 80 or 70 volts.

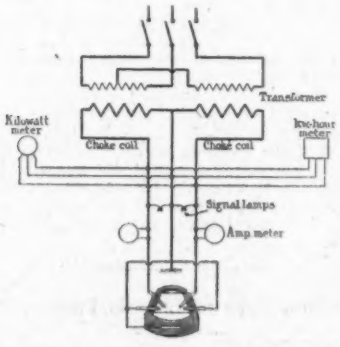



FIG. 5.—WIRING OF A TWO-PAIR SAHLIN FURNACE.

The connections for a two-pair furnace are shown in fig. 5. All the electrodes are distributed around the half of the circumference of the furnace opposite to the tapping hole and charging doors. For the smaller sizes, the electrodes are fed forward by handwheels.

For melting and refining steel, the first operation is the heating of the furnace to the proper temperature by gradually advancing the points of the convergent electrodes of each pair until an arc is formed. Experiments have proved that as long as the points of the electrodes are at a certain distance from each other an arc is formed between the two electrodes. As the electrodes approach each other this arc bends outward, forming a loop. If the distance is still further reduced, the loop breaks and the arc rushes forward, sweeping downward toward the surface of the metal like a broom. If the top electrode is advanced beyond the bottom electrode, the broom is deflected downward (fig. 6). The form and direction of the arc can easily be modified by altering the angles of the electrodes and their relative position to each other. The free-burning arc heats the furnace while empty.

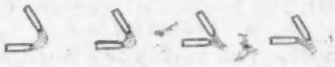


FIG. 6.—DIRECT ARCS OBSERVED WITH DIFFERENT POSITIONS OF ELECTRODES.

When the furnace is heated, current is taken off, and the electrodes are drawn toward the back wall of the furnace to prevent their being injured, while the material to be melted is pushed into the furnace through the charging door, or top. Numerous momentary arcs are formed between the upper electrodes and the charge, but as this latter is melted away in the vicinity of the electrodes, the regular free-burning "broom" arc is formed between the two electrodes and the working of the furnace settles down to normal. The radiation and reflection caused by the free-burning arc are most effective for rapid melting. As the bath is formed, this kind of arc reaches only the slag-covered surface of the metal. At this point the free-burning arcs are broken by the retirement of the lower electrodes and a direct arc is formed by the advancing of the upper inclined electrodes toward the surface of the slag. If the bottom electrode is employed, the current will penetrate toward this bottom electrode which is earthed. The furnace now creates an arc which causes a rapid circulation in the bath and direct transfer of heat to the metal.

In furnaces with more than one pair of electrodes, it is possible to have some of the electrodes produce a direct, and some a free-burning arc, thus making use of the effective radiating and reflecting action of the free-burning arc, at the same time as the bath is agitated by the direct arcs.

For use as a heating furnace for very high temperatures it is proposed to suspend the furnace shell containing the side walls and roof with the electrodes and their mechanism from four lifting rods, operated by electric motor. The bottom of the furnace, which for this work does not require any bottom electrode, would be placed on a truck. On this portable bottom would be placed the material to be heated, and the furnace body would be lowered on to the truck enclosing the pile of material. A free-burning arc would now be started between the electrodes in each pair, and the furnace would be brought up to the required temperature. The material having been thoroughly heated or calcined, the furnace body would be lifted from the truck, which would be run away to give place to a second truck loaded with fresh material. The loaded trucks could be preheated in a gas-fired furnace before the bottom was placed under the electric furnace.

The Sahlin furnace has not yet been placed on the market owing to the difficulty of its construction during the war, but a furnace is now being built in Great Britain intended for the production of steel ingots and castings.

*(To be continued.)*

## DISCUSSION AT BIRMINGHAM.

The six papers were discussed before the SOUTH-MIDLAND CENTRE of the INSTITUTION on May 7th.

Mr. F. J. MOFFETT gave a brief general account of electric furnaces followed by a *résumé* of the six papers.

Mr. C. M. WALTER followed with an account of the work which he had done on externally-wound tubular resistance furnaces. These furnaces had been successfully used by him in the research laboratory of the Birmingham Corporation gas department for heat treating and hardening of steel. Mr. Walter showed samples of articles treated, and mentioned that he had designed a furnace for hardening sewing needles in an inert atmosphere contained within an electric tubular furnace. The needles were suspended in a box or held up by a magnetised plate, and when they had been heated to the proper temperature they were dropped into an oil bath at the bottom of the furnace. This furnace had proved highly successful, and the ordinary scale-removing operation, requiring several days for its completion, was eliminated.

Mr. W. WILSON remarked that no mention had been made in any of the papers of the fact that by means of such electric furnaces it was possible to treat a wider range of iron ores than had proved to be practicable in furnaces of ordinary construction. In particular he mentioned magnetite iron sand, which existed in a certain deposit in enormous quantities and in a state of great purity. All attempts to smelt this ore in ordinary furnaces had failed owing to its finely divided state. Mr. Wilson also referred to the omission from Mr. Moffett's introductory remarks of any reference to electric furnaces for the fixation of nitrogen, and drew attention to the commercial possibility of such furnaces.

Mr. J. D. Morgan spoke on the economic aspect of the subject. Reference to efficiency figures probably did not help the prospective user very much. It was said that such furnaces gave an efficiency of 80 per cent., whereas the efficiency of solid-fuel furnaces was often very considerably lower than 1 per cent. The contrast put in this way was somewhat misleading, because the overall efficiency of a plant involving an electric furnace, *i.e.*, the efficiency from the fuel for generating electricity to the heat generated in the furnace, would not be more than 8 per cent., and it was this figure which should be compared with the performance of a solid-fuel furnace.

Mr. W. F. Whittaker asked whether it was possible to produce a downwardly deflected arc with a three-phase supply without the use of Scott connections. He pointed out that there were certain special cases in which the use of such an arrangement would be advantageous, but he had not been able to find out how it could be obtained.

## A SMALL HYDRO-ELECTRIC PLANT.

Messrs. Mitchell Bros., Old Town Mills, Hebden Bridge, have resorted to the generations of electricity from water power to drive their woollen spinning mills. Several natural springs controlled by the firm exist, and the fullest advantage has been taken of the energy available. In designing the scheme of electrification it was decided to provide a reservoir having a capacity of six million gallons, and fed by springs rising some 1,500 feet above sea level.

By means of this reservoir a fall of 500 feet has been obtained, the water being conveyed through 9-in. cast-iron pipes to the power house, which lies three-quarters of a mile below. The conditions imposed upon the contractors laying down the installation were that the turbine plant should be entirely automatic and self-governing; that it should be started and stopped from the mill half a mile away; that the speed should be kept constant under all conditions, to ensure the very steady drive required by a textile mill; and that it should be unnecessary for an attendant to pay more than one visit per day to the power house. Messrs. Mitchell Bros. report that all these conditions have been amply fulfilled by the contractors. The power house contains a tangential wheel of the Pelton type (manufactured

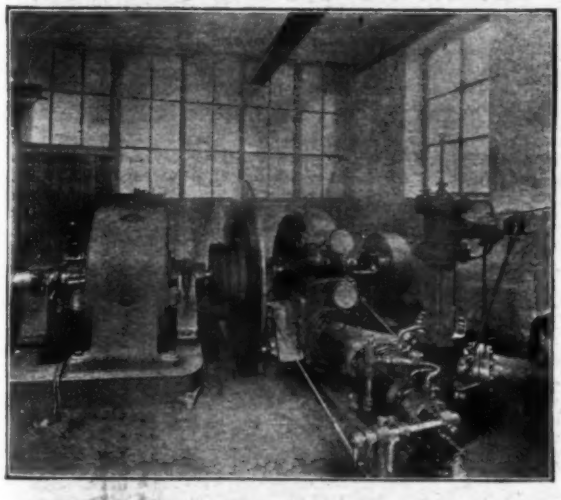


Fig. 1.—The Hydraulic Turbo-generator in Messrs. Mitchell Bros.' Power House.

by Messrs. Gilbert Gilkes & Co., Ltd., of Kendal) running at 600 r.p.m., and coupled to a 68-kw. G.E.C. "Witton" dynamo, as shown in fig. 1. The generator is compounded so that the mill voltage is maintained constant at all loads. The speed control of the turbine is obtained by Messrs. Gilkes's patent governor, in which the coupling head is mounted direct on the shaft, thereby avoiding the use of chains or belts for driving and eliminating any possible chance of the set running away through the breaking of the intervening mechanism. There are no rotating parts on the governor, so that there is nothing to heat or seize; nor are there oil pumps, moving pistons or cylinders. The result is that whereas an ordinary governor can turn off water in case of accident in less than three to five seconds, the water in this case can be shut off in a fraction of a second without any shock on the pipe-line. The governing proper is effected by means of deflectors. A simple deflector would use the full quantity of water at all loads, and would waste that which was not required. In the deflector installed a spear is inserted into the nozzle and controls the quantity of water flowing into the wheel, the motion of the spear being slow in order to avoid shock on the line, while in coming out when the load is thrown on the motion is very rapid. On tests it was found that with full load thrown off, the momentary speed variation was but 1 per cent. above the normal, while the permanent speed variation between full load and no load was one-half of 1 per cent. above and below normal.

The remote-control device comprises a hydraulic cylinder, the supply of water to which is controlled by a solenoid which operates a four-way valve. The magnets are controlled through overhead wires by a switch situated at the mill, the current for energising the magnets being taken from a battery of accumulators.

The transmission line is entirely overhead, the conductors being carried on wooden poles to the mill. The poles also

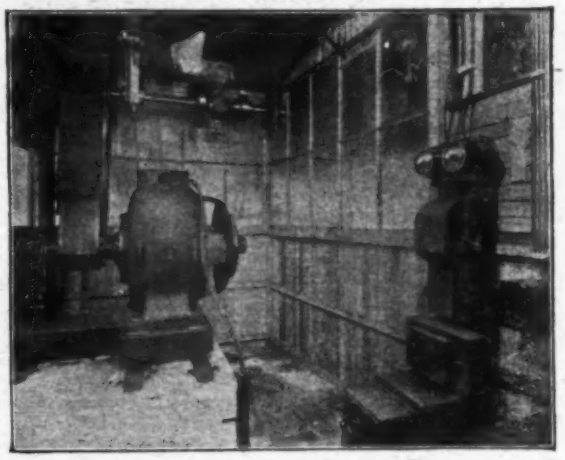


Fig. 2.—The 500-volt, 70-h.p. "Witton" Motor for Group Drive.

carry the wires for the starting and stopping gear, as well as the lighting and telephone wires. The conductors are cradled at points where the overhead line passes over public paths. This line is protected by lightning arresters at each end.

In the mill, the whole of the plant is driven by a "Witton" motor of 70 h.p. running at a speed of 630 r.p.m., the motor being housed in a totally-enclosed central motor house. The motor is seen in fig. 2.

The connection between the motor and the mill shafting is through a Hans Renold silent chain running in an oil bath, the ratio of transmission being 5 to 1. In view of the fact that the motor operates at 500 volts, a small "Witton" dynamo, driven by the mill shafting, is used to supply current for lighting at a pressure of 200 volts.

The hydraulic portion of the scheme was undertaken by Messrs. Gilbert Gilkes & Co., Ltd., of Kendal, and the whole of the electrical plant by the General Electric Co., Ltd., of Witton, Birmingham, through its office at Victoria Bridge, Manchester.

**Substitute for Platinum in Electro-Analysis.**—The scarcity and extraordinarily high price of platinum in Germany created a great demand for metal substitutes. Hence the experiments which Prof. Gewecke, of the Chemistry Department of Bonn University, made in this direction deserve consideration. According to the *Chemiker Zeitung* he endeavoured to find a suitable substitute, equivalent in all respects to the platinum dishes generally used in electro-analysis as cathodes, and weighing about 30-40 grammes. He discovered that glass dishes could be used advantageously if silver-plated inside. To obtain a thoroughly adhesive coating of silver on the glass dish, the inside must be treated with a fine sand jet to give a dull surface. This operation does not succeed quite so well with hydro-fluoric acid fumes, as the effect produced is not, as a rule, so even as with a sand jet blower. The dishes must be thoroughly cleansed with chromic acid before the first silver plating is carried out. After this preliminary treatment the glass dishes can be plated, preferably with ammoniacal solution of nitrate of silver, which has been reduced by adding 2 cb. cm. of a 40 per cent. solution of formaline. At a temperature of at the most 30 deg. C. a silver precipitate of "mirror" is obtained of 0.03 to 0.05 grammes in three to four minutes. It is evenly dull throughout, and when looked at against the light appears a very dark blue. The dish when dry is fitted with a thin strip of platinum 2 mm. broad, of which the one end touches the silver coating, while the other is bent outwards over the edge of the dish and provided with a pressure screw. Trials which had been made to find a substitute for platinum anodes, *e.g.*, by using carbon anodes, have, so far, not given satisfactory results, but are to be continued with Acheson graphite. Trials carried out with these silver-plated glass dishes show that they can very well be used as substitutes for the expensive platinum ones.

# LEGAL.

B.T.H. Co., Ltd., v. Duram, Ltd.

In the Court of Appeal, last week, before the Master of the Rolls and Lords Justices Warrington and Duke, an appeal was heard by the British Thomson-Houston Co., Ltd., from the judgment of Mr. Justice Sargant, in the Chancery Division, dismissing its application for leave to amend a claim in its patent specification regarding a process for the treatment of metallic tungsten, and for the manufacture of tungsten filaments for electric lamps. As reported in our issue of April 25th, 1919, Mr. Justice Sargant, in dismissing the application, said the amendment was not duly authorised by the Act, and apart from the Act the circumstances were not such as to justify the Court in exercising its discretion in favour of the applicants.

Mr. Colefax, K.C., Mr. J. Hunter Gray, K.C., and Mr. Basil Watson appeared for the appellants, and Mr. Thomas Terrell, K.C., Mr. Kerly, K.C., and Mr. Courtney Terrell for Duram, Ltd., and Mr. Mark Romer, K.C., and Mr. R. Frost for other respondents (opponents to the application), and Mr. Austen Cartmell represented the Board of Trade.

Mr. Colefax said there were several actions pending on the patent. Mr. Frost appeared for the Corona Lamp Works, Ltd. There was an action pending against them, and they counterclaimed for revocation. All the opponents to the application to amend were defendants in the litigation except Duram, Ltd., who were the petitioners for revocation. There were also two or three firms in addition to the defendants who had given notice of opposition to the application to amend. The difficulty which had opposed the path of the present patent in the Courts was the use of the words "coherent tungsten," which appeared in the specification, and the construction which the Court had put upon the first claim of the specification. "Coherent tungsten" included fused tungsten. What the patentees had done was to show how to get coherent tungsten, and the patent referred to working it without hammering, treating, and rolling, &c. The learned counsel contended that the amendment which the appellants sought would not, as Mr. Justice Sargant had said, enlarge the invention, and that his clients were entitled to have leave to amend.

Mr. J. Hunter Gray followed on the same side.

The case is continuing.

Marconi's Imperial Wireless Chain Litigation.

For the purpose of the assessment of damages payable by the Crown to Marconi's Wireless Telegraph Co. in the action it brought in March, 1918, Mr. Justice Lawrence sat as arbitrator in the King's Bench Division on Thursday, May 15th.

Counsel engaged in the arbitration were: For the Crown, the Attorney-General (Sir Gordon Hewart, K.C.), the Solicitor-General (Sir Ernest Pollock, K.C.), Mr. Terrell, K.C., the Hon. E. Charteris, K.C., and Mr. Giveen; for the Marconi Co., Sir Edward Carson, K.C., Mr. Leslie Scott, K.C., Mr. Hunter Gray, K.C., Mr. Stuart Bevan, K.C., and Mr. Hildesley.

Sir Edward Carson stated that that sitting was merely a preliminary one. The main question was, what were the damages to be paid for breach of the contract. So far as he could see his Lordship would have to decide whether the contract existed over 18 or 28 years, and he would have to be somewhat sympathetic in his estimation of the damages, taking into consideration eventualities which might or might not arise. The main question he would have to determine was: What did the company lose by the breach of the contract?

His Lordship then fixed the date of hearing for June 2nd.

Calmont King & Co., Ltd., v. Groom.

In the City of London Court, on May 15th, before his Honour Judge Atherley-Jones, K.C., a claim was made by Calmont King & Co., Ltd., electrical engineers, of Milton Street, E.C., against Mr. G. W. Groom, of St. Albans, for £3 for six dozen refill electric lamps supplied.

Mr. H. Strouts, plaintiffs' solicitor, said that in July of last year the defendant gave a written order for electric lamps. There were three dozen refills ordered for electric torches, and they were to be supplied in November and December. The other goods were duly delivered and paid for, but when the refills were delivered acceptance was refused, the defendant saying that they were not ordered. He added that at the beginning of November he could not get any batteries from the plaintiffs, and that he had lost all his trade.

Mr. Mardlin, plaintiffs' manager, said that they took thousands of orders for delivery during the month. That meant that they could deliver at any time during the month. They never undertook delivery by any specific date. They made about 20,000 lamps a day.

Defendant said plaintiffs had sent him six dozen refills above the contract.

Mr. Mardlin said that was not so. The order was for six dozen in November and December. That meant six dozen in each month obviously.

Defendant: No, it meant I was only to take three dozen in November and three dozen in December. When I say six dozen in November and December it means three dozen in each month.

Mr. Mardlin: No. I could show you thousands of orders in support of my view. When a man says six dozen in November and December and January he does not mean he wants two dozen a month, but six dozen in the month.

Judge Atherley-Jones: If I order six dozen in November and December does that mean I am to take 12 dozen and not six?

Mr. Mardlin said it did.

Defendant: I say it does not mean anything of the sort. I was away doing my bit when the order was given.

Judge Atherley-Jones said it was not an easy case to decide. The documentary evidence was all in favour of the plaintiffs. He had not the slightest doubt that there had been a misunderstanding and that the plaintiffs were quite honest in the matter. If the order meant 12 dozen in November and December, it should have said so. While the defendant's letter could be read as the defendant contended, he thought on the whole he must find against the plaintiffs. As a commercial man he would say six dozen in November and December meant six dozen in all and not 12 dozen. There was a delivery of only three dozen in November.

Mr. Strouts: That is because we were short of commodities, and sent half the quantity.

Judge Atherley-Jones did not doubt there were many possible explanations. But he must find for the defendant with costs. It was the sort of case that might be argued in the Court of Appeal for three days.

## CORRESPONDENCE.

*Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

### The E.P.E.A. Award.

Your correspondent, Mr. Harding, can rest assured that he is not the only chief engineer of a small undertaking who has refrained from joining a Trade or professional Union on the ground that it would be *infra dig.*; one can quite imagine them doing so. I suppose he and his colleagues would also consider it *infra dig.* to accept from their employers any advances which might be offered them as the result of any members of their staff who, through their Union, had advances granted to them, and so brought their salaries too dangerously near their own. With regard to his query as to whether some of the big stations participate, and the small ones not, I would remind him that in certain small stations the only man eligible for membership of the E.P.E.A. is the chief engineer, and if he happens to be one of Mr. Harding's colleagues, how can the award apply?

Wessex.

*May 17th, 1919.*

### The Re-settlement of Officers.

Your criticism of my letter in your leading column of the 16th inst. somewhat resembles a Minister's reply to a question asked in the House. It seems to suggest that nothing better could be expected, and that such bad methods are bound to exist. Certainly, it would be a miracle if all things went well.

With regard to "the machinery of the Appointments Board not being ready when hostilities ceased," all I can say is that it ought to have been. If I remember rightly, the skeleton of the system of demobilisation was drawn up in 1917. Do you mean to say that the problem of re-settlement was left alone until the time for demobilising the services? It didn't take long to arrange for the training of the New Armies after the outbreak of war. Of course that was something of greater importance, and there was an organiser behind that. I am well aware of the large number of young men between the ages of 22 and 23 who have spent the best part of their life in the Army or Navy. I am one of them, as I shall not be 24 until August next. That, however, does not excuse the Board in the least.

You respect my independence in not accepting the O.W.D. of 29s. weekly, but think I am making a mistake. It can hardly be termed "charity," but I don't see how you can compare it with the pay received whilst on active service. I was in the Army for a definite purpose, and there was certain work for me to do. Whether I did that work does not matter. The O.W.D. is given for doing nothing, and in spite of its being a meagre allowance, thousands manage to exist on it, and take cover when work comes their way. It encourages unemployment, as was shown a few days ago, when the Minister for Labour was told in the House that of 82 men sent from the Labour Exchange to a certain engineering works, only two turned up. I do not like rubbing shoulder to shoulder with this type of man. Now you know why I am too proud to claim it. I still have a few pounds left, and when that is spent I shall take off my "starched collar," leave the district, and take the first thing that comes my way—road-sweeping or hawking.

The problem of re-settlement is a difficult one as every sane-minded person knows, but it hasn't taken our friends across the Atlantic long to get the matter in hand. A few weeks ago I was speaking to the counter clerk at the G.P.O. in the town in which I

reside, when an American traveller came in and handed a cablegram across the counter, and paid £12 10s. for it. The clerk told me later that he came in two or three times a day with 'grams costing £3 or £4. Evidently their motto isn't "Wait and see." Procrastination, £400 a year, and 29s. a week, are the chief causes of all our trouble and delay.

I have just re-read my letter of the 6th inst., and it looks to me as if I am accusing employers of "war profiteering." That, however, was due to hurried writing. To insist upon the Excess Profits Tax at 80 per cent. now the war is over, betrays an ignorance of the business needs in the face of reconstructing our industries on a peace footing. However, I don't think it is necessary to dwell upon the subject any more this week, as I expect there will be a few replies to my former letter alongside this.

**Still Trying.**

*May 19th*, 1919.

### The Mechanical Equivalent of Heat.

What *is* the mechanical equivalent of heat—772, 778, or 780 ft.-lb.?

**Ignoramus.**

[Quite a lot could be written on this subject. As the temperature at which the British thermal unit is taken has never been authoritatively settled, its value depends on whether the unit is defined to be the heat required to raise 1 lb. of water from 59° to 60° F., or to be $\frac{1}{180}$th part of the heat required to raise 1 lb. of water from 32° to 212° F. The calorie is fixed on the latter basis—$\frac{1}{100}$th of the heat required to raise 1 gm. of water from 0° to 100° C., which is practically the same as that required to raise it from 17° to 18° C. The mechanical equivalent is 778·2 ft.-lb. if the B.TH.U. is defined at 59°—60° F., and 777·5 ft.-lb. if it is defined at 63°—64° F. (which is identical with the mean value between 32° and 212° F.). Another value is defined at 68° F. The value usually accepted is 778 ft.-lb. —EDS. ELEC. REV.]

### The Election of the I.E.E. Council.

I read with interest the letter of your correspondent and the editorial in reference thereto. It will be interesting to see whether the Council and the Institution will take the necessary steps at once to amend the by-laws so as to enable the Associate Members to nominate their own class for election to the Council.

As one who believes that the Council would be sympathetic with the justice of such an amendment, I am waiting to see whether it will put the necessary machinery in motion, or whether the members will be put to the inconvenience and trouble of calling the necessary special meetings to enable the by-laws to be so altered.

A good many of the adverse criticisms of the Council are, no doubt, unnecessary, and are probably due to circumstances of which the ordinary member has no knowledge; but explanations from time to time of the action of the Council on certain matters would remove what one imagines to be uncalled-for criticism. Take, for example, the calling of the annual general meeting. Now that the war is over the necessity, or otherwise, which has existed for early meetings no longer exists. It has been called this year at 2.30 p.m. on a Thursday afternoon, which precludes all members who are actively engaged in business from attending. Moreover, it prevents the largest body and class of member from representing any views which might be to the benefit of the Institution.

**P. A. M.**

*May 20th*, 1919.

### The Southampton Appointment.

In order to give expression to their resentment at the manner in which the Southampton Corporation Electricity Committee has dealt with the vacant position of borough electrical engineer, the whole of the staff and employés of the department have signed the enclosed protest, copies of which have been forwarded to the Southampton Corporation, A.S.E., E.T.U., the local Press, and the local Trades and Labour Council.

It is felt that the widest publicity should be given to the circumstances both in the interests of the electrical profession and for the maintenance of integrity in municipal control, and while seeking the hospitality of your columns for this purpose, it is deeply regretted that the adoption of such a course should become necessary.

**A. Reeve**, *Secretary, Electrical Trades Union.*

Southampton, *May 19th*, 1919.

We, representing all grades of the staff and employés of the Southampton Corporation Electricity Department, wish to lodge an emphatic protest against the irregular and questionable tactics adopted in filling the vacant position of borough electrical engineer.

Owing to the publicity given to the Electricity Committee's action both in the lay and technical Press generally, the town has been brought into disrepute throughout the electrical supply industry, and it is undoubtedly a fact that the undertaking is boycotted by all electrical engineers of standing, many of whom under normal conditions would have applied for the position, and from among whom one of high qualifications could have been appointed whose services could have been beneficially devoted to the department.

The low age limit, which was obviously fixed to favour one applicant, has certainly prevented many suitable engineers from applying for the position.

We would also point out that the successful operation and welfare of the department is affected by the loyalty and enthusiasm of the staff and employés, and this can only be maintained when there is confidence in the Committee. It is, therefore, felt that no confidence can be placed in those who have been responsible for bringing the Department under reproach, and we consider that the members of the Electricity Committee should be called upon to resign forthwith. Notification of this should appear in the technical Press, and the position should be re-advertised, at the same time giving an undertaking that the appointment will be made in a straightforward manner. By this means some of the best engineers might be induced to apply for the position, and the present stigma be removed from the town and undertaking.

## AN ELECTRIC FURNACE IN THE PHILADELPHIA MINT.

A RENNERFELT electric furnace was installed in the Philadelphia Mint in 1917 for melting silver, nickel, and bronze alloys. It had a capacity of 1,000 lb., and effected a saving, as compared with gas and crucible melting, of approximately 40 per cent. (for nickel bronze, 50 per cent.).

New furnaces of 1,000 and 2,000-lb.-capacity are to be added; these will rotate about a pouring lip as fulcrum, and permit metal to be poured directly into moulds mounted on trucks under the pouring lip. The new type will have automatically-controlled electrode feeds, by which the temperature will be regulated.

The original furnace was first used on July 9th, 1917; three-phase, 60-cycle current received from outside at 2,200 volts was transformed at the furnace to 110 volts. The total weight of the furnace was 12 tons.

No absorption by the nickel of the carbon of the incandescent electrodes was observed, but the results have shown that every precaution must be taken to keep the surface of the molten metal covered, if good unoxidised ingots are to be obtained. Should the furnace attendant not keep the doors closed and the metal covered, trouble would result. In any open furnace there will always be some trouble with the refractories fusing and being carried over into the mould; practically all this can be obviated if a spout is built upon the ladle, so as to secure the results of a bottom pourer (where the ladle system is used). With a ladle system there is always a loss of heat between the furnace and the moulds on account of the chilling effect of a thin stream of metal (18 in. or more) in the spout.

The Mint adopted the process of hanging a 200-lb. ladle in a shank on bearings, which can be rapidly filled. Turntables carrying the moulds are within 10 ft. of the furnace mouth, and the operation of taking off the heat with two ladles pouring simultaneously into two sets of vertical moulds takes 15 minutes, and is done with no confusion. A shank with one swivel is preferred. The weight of the ladle, shank, and metal is about 200 lb., but this weight is borne by the two men for only a fraction of a minute, after which the shank is placed on a bail on a chain hoist in a position for pouring. As the ladle is emptied, the man on the swivel end of the shank operates the chain to maintain a proper pouring distance between the lip of the ladle and the mouth of the mould. To prevent oxidisation of the metal in the ladle, as pouring from the furnace starts, granulated pine charcoal is immediately placed on top of the molten metal in the ladle. Owing to a specially-constructed skimming spout, the charcoal is held back, the surface remains well covered, and only clear metal, free from carbon, flows into the moulds. Ordinarily, no metal shows results of oxidisation within the furnace itself; yet it is possible for it to oxidise, particularly with scrap metal, if all due precautions are not exercised. The above furnace is rated at 125 KW. and 750 lb. of metal: it is found, however, that 1,000 lb. per charge is correct.

The furnace is never allowed to cool off entirely, except when repairs are necessary. After a run of 8 to 12 hours, if a shut-down period follows, coke or lump charcoal is thrown in and renewed from time to time until the current is put on. Analysis of cupro-nickel and bronze shows a good mixture—the former requires no stirring during a melt. The volatilisation loss appears to be somewhat higher on zinc in the bronze alloy than in a crucible furnace, the assayer reporting losses averaging about ½ to ¾ per cent. These figures, however, are not yet conclusive. Silver coin melting results show homogeneity in samples taken from the top and bottom of a 1,000-lb. melt.

The first roof on the furnace lasted for 799 heats, while the cylinder was not renewed until 1,277 heats had been made. These were of cupro-nickel and bronze, the former predominating. On a second run the roof lasted for over 1,000 heats.

| Variety of metal. | Gross ounces melted. | Time to melt 1,000 lb., in minutes, hot furnace. | Kilowatt-hour consumption per net ton, average. |
|---|---|---|---|
| Cupro-nickel... ... | 15,980,341·80 | 100 | 500 |
| Bronze ... ... | 11,988,272·23 | 70 | 300 |
| Silver... ... ... | 10,031,101·00 | 60 | 198 |
| Tin ... ... ... | 57,147·00 | 10 | 46 |

The cost of melting cupro-nickel in this electric furnace is $9.45 per net ton, which is less by 50 per cent. than is shown with gas and crucible-furnace melting.

The above notes are taken from the Annual Report of the Director of the Mint, Treasury Department, Washington.

# BUSINESS NOTES.

**Transhipment of Goods in the United Kingdom.**—The Export Licence Department announces that goods of any description (other than foodstuffs from Europe destined for extra-European destinations) may be brought to this country for transhipment to any destination to which exports are ordinarily allowed, provided that in the case of any goods in Sections "A" or "B" of the list of prohibited exports the bills of lading clearly show that the goods were intended for transhipment before they left the country of origin, or that other satisfactory evidence to that effect is produced to the Export Licence Department. If these conditions are observed it will, therefore, in future be unnecessary to obtain the provisional approval of that Department before bringing goods to this country for transhipment. In the case of goods destined for the border neutral countries in Europe, the goods must be consigned to the approved Import Associations in accordance with the regulations for the time being in force in respect of direct exports from the United Kingdom. Applications for transhipment permits should in all cases still be made on Form S. 90, to the Customs authorities at the port of arrival; and as regards any goods in Sections "A" or "B" of the lists of prohibited exports, the bills of lading if available should accompany the S. 90 Form.

**Starting and Lighting Batteries.**—The Exide battery and its adaptability to motor-car starting and lighting service is well known. For many years the CHLORIDE ELECTRICAL STORAGE CO., LTD., has been making Exide batteries of similar design to the Exide fitted to so many American cars. During the war this firm's output has been entirely absorbed by the Admiralty for the underwater propulsion of submarines, but it is now in a position to offer these batteries for starting and lighting purposes. This battery, which has given satisfaction on American cars, is quite capable of performing the same service on British-built cars, which operate, for the most part, where the variations of temperature are not so great.

**Import Restrictions.**—The President of the Board of Trade, after duly considering the recommendations of the Consultative Council on Imports, has given the following further directions with regard to the Prohibitions of Import:—

The restrictions on the importation of the following articles are to be removed:—

146. Motor-car jacks and track jacks.
147. Files.
148. Bronze castings (machine or phosphor bronze).
154. Friction clutches.
155. Piercers, punches, and round-hole perforators.
156. Adjustable pipe tongs.
157. Flexible metallic tubing.
167. Time-recorder parts.
168. Rubber manufactures other than tires, boots and shoes, and stationery articles.

In accordance with the above, general licences have been issued for all the foregoing articles.

The importation of the following articles is to be licensed only exceptionally as and when required.

173. Portable shop cranes, electric hoists, and steel pulley blocks, except Yale triplex pulley blocks and Yale triplex electric hoists, which are to be rationed to regular pre-war importers at the rate of 100 per cent. of 1913 importations.
174. All types of jacks except motor-car jacks and track jacks.
175. Crowbars, pinch bars, or hand-wagon movers.
183. Trolleys and trucks for warehouse and wharf.
184. Shaft bearings, shaft-bearing boxes, blocks for shafting, shaft collars, shaft coupling, shaft hangers, shaft hanger frames.
185. Iron and steel pulleys, except pressed steel pulleys, of which 200 tons (actual net weight) are to be admitted until September 1st, 1919.
186. Fan blowers and forges.
187. Metal baths and fittings thereof.
188. Flat or laundry irons.
189. Cast-iron pipe fittings and cast-iron pipes, rainwater pipes, and soil-guttering pipes, in so far as at present prohibited.
190. Aluminium hollow-ware.
191. Iron and steel welded tubes up to 2 in. in diameter.

The importation of the following articles is to be restricted as shown:—

195. Rubber tires are to be admitted at the rate of 50 per cent. of 1913 importations.
196. Rubber boots and shoes are to be admitted at the rate of 50 per cent. of 1913 importations.

Applications for special licences should be made, as usual, to the Department of Import Restrictions, 22, Carlisle Place, London, S.W. 1.

**Export Restrictions.**—A further list of alterations in export restrictions is published in the *London Gazette* for May 16th.

**Non-Ferrous Metal Industry Act.**—Additions to the list of licences granted under this Act appear in the *London Gazette* for May 16th.

**A Committee on Workmen's Compensation.**—The Home Secretary has appointed a Committee to inquire into the working of the present system of the payment of compensation to workmen for injuries sustained in the course of employment and to consider and report whether it would be desirable to establish a system of accident assurance, under the control or supervision of the State; and to report, further, what alterations of the law will be required to remedy defects which experience has disclosed or to give effect to their recommendations.

Mr. H. Holman Gregory, K.C., M.P., is chairman of the Committee. The secretary is Mr. G. R. A. Buckland, the Home Office, Whitehall.

**Poland.**—According to *l'Electricité*, a strong company is under formation at Warsaw, with a capital of 10,000,000 Polish marks, to organise the importation of raw materials into Poland from Allied countries. Of the company's capital, 25 per cent. will be French, 25 per cent. British, and 50 per cent. Polish.

**British Trade with Rhineland.**—Some 70 British firms are represented at Cologne, and recently they decided to organise a British Chamber of Commerce there, in order to assist British enterprise. An Information Bureau is being organised at 136, Hohestrasse, Cologne.

**Patent Restorations.**—Orders have been issued restoring the following patents:—R. Haddan (Universal Turbine Co.), for "Improvements in fluid pressure or steam turbine engines," No. 614, of 1913; Mr. T. P. Payne, for "Improvements in metal-punching machines," Nos. 22,067 and 8, of 1913.

**Magneto v. Coil Ignition.**—According to the *Financial Times*, at a recent interview Mr. Goodwin, of MESSRS. C. A. VANDERVELL & CO., LTD., stated that though his firm was turning out seven or eight hundred magnetos weekly, these were for motor-cycles only; the company did not manufacture magnetos for cars, because it believed that ignition by means of the high-pressure coil and distributor could be made to give even better results than the magneto, and a greatly improved apparatus would be put on the market within a few months. The company had obtained better results than the American coil makers with half the current consumption. At present, output was hampered by the lack of skilled labour, and it was impossible to cope with the number of orders that were being received for batteries.

**New French Electrical Engineering Companies.**—L'Electro-Construction, Société d'Applications de l'Electricité is the name of a new electrical engineering concern which has lately been formed in Paris with a capital of £9,000.

The shareholders of the Energie Electrique de la Basse Loire have been called together to sanction an increase of the present capital of 6,000,000 fr.

Among French companies recently formed are the following:—Constructions Electriques du Rhône, procédés Dick, Kerr, 8,000,000 fr., Paris; Amondraz et Cie, hydroelectric sawmills, 100,000 fr., Paris; Etablissements P.-J. Hazard, electric material, &c., 2,000,000 fr., Paris; Etablissements Postel, electric installations, &c., 250,000 fr., Paris; Liliaz Frères, hydro-electrometallurgic works, &c., 4,600,000 fr., Paris.

There has been formed at Paris a company under the style of Baudin et Cie, with a capital of 175,000 fr., for mechanical and electrical objects.

E. Gougé et E. Vilcoq is the title of a concern formed at Paris, with a capital of 25,000 fr., to carry out electrical installations.

**Building Costs.**—In the Standing Committee on the Civil Service Estimates for the year ending March 31st, 1920, Mr. Illingworth, the Postmaster-General, made a statement concerning the rebuilding of the General Post Office, East. The original total estimate was £210,000, and the revised total estimate provided for an expenditure of £525,000. In addition, provision was made for the expenditure of a sum of £175,000, chargeable to the telephone capital account. The building was mainly wanted for the Accountant-General's department, which, with its staff of 3,000, was now scattered all over London. The country generally insisted on better and proper management of the Post Office in every direction. Things had got out of order, and they must now get them back to better businesslike management. Sir Alfred Mond, the First Commissioner of Works, said that the large increase in the estimate was largely due to the abnormal increase in the cost of materials. Bricks, which were 25s. a thousand before the war, were now 90s. a thousand, while Portland cement had gone up 98 per cent., timber 160 per cent., switches 137 per cent., electric light installation 100 per cent., lead 100 per cent., and cheap glass 153 per cent. He did not think any real economy could be achieved by postponing the scheme. The estimates were agreed to.—*The Times.*

**Trade Announcements.**—MR. GEO. MORRISON, electrical engineer, has opened new premises at 81, Fishergate, Preston, with Mr. W. Lewthwaite as manager. He invites electrical firms to forward catalogues and price lists there.

Mr. J. M. Devine, who has been carrying on business as electrical and mechanical engineer, at 17, Franklin Street, Bridgeton, Glasgow, has entered into partnership with Mr. T. J. McCosh, late of Wm. Wilson & Co., Tollcross, as from May 1st, 1919. The new firm will take over Mr. Devine's business, and trade under the name of MCCOSH & DEVINE, at 55-57, Peel Street, Mile End, Glasgow, as electrical, motor and general engineers. Manufacturers and agents are invited to forward catalogues.

MESSRS. WARD & GOLDSTONE have removed from their Glasgow offices and showrooms to more commodious and central premises, which will be opened on the 23rd inst., at Mercantile Chambers, 65, Bothwell Street, Glasgow.

MR. HUGH GOLDIE has opened an electrical engineering business at 87, Bank Street, Coatbridge.

THE HOFFMANN MANUFACTURING CO.'s Manchester office has been removed to Cleveland Buildings, 94, Market Street, Manchester. Telegraphic address, "Mannhoff, Manchester"; telephone No., "2761 City." A staff of trained engineers is stationed at the office, and emergency stocks of bearings are carried.

With reference to a note which appeared in our issue of May 2nd, Messrs. Bullers, Ltd., desire to point out that Mr. G. V. Twiss occupied the position of engineer with them, not technical adviser, and that high-tension work was an appreciable part of their business before he entered their service.

**Openings for Trade in Greece.**—In a recent issue allusion was made to the opportunity offered by the Exhibition at Athens organised by the Federation of British Industries for reintroducing British manufactures into the Grecian and surrounding markets. The classes of goods of interest to the electrical and allied trades which figured amongst Greece's purchases prior to the war included all kinds of manufactured iron and steel, notably galvanised wares, wire, sheet iron, iron bars, builders' hardware, and cutlery.

Machines and equipment will be needed for carrying on the varied mineral industries, as well as in other smaller vocations, *e.g.*, the manufacture of textiles, ice, paper, flour, liquors, leather goods, and furniture.

The Grecian Government recently prepared an official statement of the post-war requirements of its country. It is not surprising to learn from this statement that the country is short of all machinery and equipment. Furthermore, it is a fact which has an important bearing upon the future needs of the country that the shortage of fuel and the increased cost of labour will create an abnormal demand for labour-saving devices and various kinds of machines not hitherto exported to Greece to any great extent.

Greece is reported to possess plenty of iron ore of good quality, plant for the working of which it is desired to obtain and set up.

At Esoreaus it is proposed to equip shipyards in order to bring the Grecian merchant marine back to its pre-war tonnage. It is said that 30 per cent. of its ships have been destroyed by submarines.

There are schemes on foot also for extending the manufacture of fertilisers and cement. The most active industrial district in Greece is Attica-Beotia. Considerable development is anticipated, too, at Salonica. Lathes and machine tools, together with boring, riveting, and polishing machines, are in demand. There is a certain limited output by local factories of pumps, boilers, presses, and the simpler kinds of agricultural machinery, but nevertheless there is plenty of scope for the sale of the imported article.

The importation of tubular boilers is of prime importance to Grecian industry.

Other types of engines and motors, it must be remembered, are also needed, notably turbines for the utilisation of water power, to develop which the Grecian Government has created a special department in the Ministry of Communications.

According to the latest industrial census, hydraulic power developed thus far in Greece amounts to only 6,272 H.P. Flour mills use 1,662 H.P., oil factories 202 H.P., chemical producers 1,095 H.P., cotton, woollen, and thread mills 3,228 H.P. The whole amount is but one-tenth of the potential hydraulic power of the country. Indeed, it is officially stated that steps are soon to be taken to make Greece's lakes and rivers yield 66,000 H.P., apportioned as follows:—

| | H.P. |
|---|---|
| Lake Ostrovo, the Voda River, with three dams at Vladovo, Vodena, and the Divies River ... | 34,000 |
| Axios River ... ... ... ... ... ... | 40,000 |
| Aliakmon River ... ... ... ... ... ... | 3,000 |
| Moussa Falls ... ... ... ... ... ... | 4,000 |
| Verrin Falls ... ... ... ... ... ... | 2,000 |
| Gorgopotamos River ... ... ... ... ... | 2,000 |
| Reneos River ... ... ... ... ... ... | 3,500 |
| Strymon River (probably) ... ... ... ... | 3,500 |
| Other falls and rivers ... ... ... ... ... | 10,000 |

The larger sources of power are to be worked either by the State itself or by companies to which grants are to be made under certain conditions.

The idea is to use the power obtained chiefly in the production of high-pressure electrical energy for the manufacture of nitrogenous fertilisers (calcium cyanamide), and also for supplying light to certain cities. When these plans mature it will be necessary to import large quantities of generators, transformers, transmission materials, and, in general, all accessory equipment.

At present the engine likely to be in greatest demand is the Diesel type. A lot of machinery will be required at the seaports, *e.g.*, steam or electric cranes. Up-to-date equipment is lacking at Pirœus, Patras, Volo, Salonica, and Syra. Elevators and conveyors are needed for factories, hotels, as well as private residences.

**British Trade Mark Applications.**—Appended is a summary of the recent applications for British trade marks in respect of productions connected with the electrical industries:—

Saturn (letters and design). No. 388,765. Class 8. Electric cables. H. W. Smith & Co., Ltd., Lydbrook, Gloucester. February 28th, 1919.

Kaleflex. No. 398,936. Class 8. Rubber insulated flexible electric cables. Callender's Cable & Construction Co., Ltd., Hamilton House, Victoria Embankment, London, E.C. March 5th, 1919.

Maxlumi. No. 387,621. Class 13. Electric lamps and electric lanterns and reflectors and other electric lighting fittings. Veritys, Ltd., 91, King Street, Covent Garden, London, W.C. January 16th, 1919.

Autopax. No. 387,978. Class 13, and No. 387,979, Class 18. Electric heating and soldering irons and electric cooking utensils and plant. Automatic Telephone Manufacturing Co., Ltd., Milton Road, Edge Lane, Liverpool. February 2nd, 1919.

Luxo. No. 388,661. Class 4. Electric carbons. Fuller's Carbon & Electrical Co., Ltd., Chadwell Heath, Essex. February 25th, 1919.

Vanduara. Nos. 388,399, 388,400, and 388,402. Classes 1, 10, and 40. Electrical insulating compositions and materials. John MacLennan & Co., 166, Ingram Street, Glasgow. February 17th, 1919.

Expreso. No. 389,092. Class 13. Electrical accessories. Henry G. Osborn, 9, Rathbone Place, Oxford Street, London, W. March 10th, 1919.

Eraform. No. 386,719. Class 8. Telephone and the like receivers, and attachments thereto. Alexander Marr, 23, Reynells Road, Longsight, Manchester. December 11th, 1918.

Ysolyn. No. 388,866. Class 50. Electrical insulating preparations and substances. Portholme Aircraft Co., Ltd., St. John Street, Huntingdon, March 4th, 1919.

Elo (letters combined with key design). No. 389,579. Class 50. Electrical insulating materials made of asbestos, mica, resin, shellac, oils, &c. Arnold T. Birkby & F. E. Birkby, Woodfield Mills, Liversedge, Yorks. March 26th, 1919.

**South African Electrical Market.**—According to the *South African and Mining Journal* of April 12th, the electrical market is, if anything, worse than before, but hopes are entertained that when the builders' strike is settled quite a jump will take place in business and the prices firm up. During the week there have been inquiries for lamps, and many forward orders booked, always subject to normal conditions. A leading distributing house used to dispose of fifteen or sixteen hundred pounds' worth of lamps per month, but now the demand as compared with that turnover is small, therefore stocks have accumulated very considerably. A firm received a lot of material during the week, representing some £3,000, and quantities, it is understood, are on the water, which may mean a lowering of prices in the near future. Country business continues pretty fair.

**Excess Profits and Trade.**—At the annual dinner of the Association of English Country Bankers and the Central Association of Bankers last week, according to *The Times*, Lord Faber welcomed the reduction of the excess profits duty, which had proved a great drag on trade. Germany could pay us to a small extent in timber, potash, &c., but she could pay us very well by using her industry to manufacture goods and send them to England. We should then be up against all sections of labour in this country. That was why it was difficult to get payment from Germany, and why, he was afraid, the payment would have to be rather protracted.

Mr. Illingworth, alluding to the excess profits duty, said that before he joined the Government he was on the Excess Profits Appeal Board in London, and the cases that came before them there proved that the tax, though just in theory, was one of the most unjust taxes ever imposed upon any community in the history of finance in this country. For the time being the injustice would be alleviated somewhat by the reduction of the tax to 40 per cent., and that would result, he hoped, in a certain amount of increased activity in business enterprise. The crushing financial burden which was on the country imposed a great and serious task on the trade community. There would have to be greater production, and employers and workers would have to work together harmoniously to create wealth which had been destroyed through the ravages of war. Bankers would have to be exceedingly liberal in their advances, not only advancing money on gilt-edged securities, but also on the character, the reputation, and the knowledge of those who were conducting businesses. If that were not done, he could assure them in all seriousness that they were looking for trouble and would find it very quickly. He thought the outlook for trade, when peace was signed and things got more or less into a normal state, would be more brilliant than it had been for many years. Trade must, however, be freed from Government control at the earliest possible moment.

**Enemy Camouflage.** — *La Technique Moderne* calls attention to the fact that Germans, Austrians, and even Turks, are opening offices and works in Switzerland, and claiming that their products are "made in Switzerland." As a matter of fact, these works are only used for the assemblage of parts, and the goods are really of enemy origin. This contingency has not been overlooked here, but the word of warning is well timed.

**Dissolutions and Liquidations.** — The partnership between Messrs. F. Gill & W. W. Cook, consulting engineers, of Winchester House, E.C., will be dissolved by mutual consent as from May 31st 1919. Mr. Gill, who for the last two years has been with the Ministry of Munitions and is now a Controller of the Central Stores Department, will, on relinquishing that office on June 30th next, join the Western Electric Co. as their European chief engineer.

GELL TELEGRAPHIC APPLIANCES SYNDICATE, LTD.—Winding-up voluntarily. Liquidator, Mr. A. F. Dickin, Sardinia House, Kingsway, W.C. 2. Meeting of creditors at Sardinia House, May 27th.

**Export of Coal.**—In conformity with the policy of relaxing controls and facilitating the return to normal conditions, certain changes have recently been made in the conditions affecting the sale of coal for export, and it is now proposed, *inter alia*, to terminate the system of limited prices at present in operation in the case of coal shipped to France, Italy, and other Allied countries.

**Book Notices.**—*Electric Lighting Costs*, 1914-1919. London: Tyler & Freeman.—In this pamphlet Messrs. Tyler and Freeman give the results of a series of estimates prepared to ascertain the average increase in the cost of electric lighting installations during the last five years; for this purpose they have taken actual examples of work carried out either in 1914 or in 1919, and have got out estimates for both years, as well as alternative prices for other systems of wiring. The cases dealt with include small and large private houses, factories, flats, a church, and a London club; sufficient detail is given to serve the purpose in view. From a survey of the pages we gather that the increase ranges between 100 and 150 per cent., but in most cases is in the neighbourhood of 115-125 per cent. A table of costs of materials is added, which shows that these have advanced greatly during the interval; tubing, lead-covered cables, fuseboards, &c., have gone up by 100 to 200 per cent., wood casing and opal shades by more than double these rates, but ordinary cables have not advanced so much, and lamps have only put on 20 per cent. Wages have increased 100-120 per cent., but we regret to see that labour costs have gone up still more, as the output has fallen.

This pamphlet should be of great value to contractors, as it will assist them in checking their estimates, and will afford useful aid in convincing the purchaser that he is not being overcharged—though it is, of course, issued only to the trade. No useful purpose can be served by concealing the truth. In reality, of course, prices have not risen much—the value of "money" has gone down to one-half.

Circular No 79 of the Bureau of Standards. "Electrical Characteristics and Testing of Dry Cells." Washington: Government Printing Office. Price 10 cents.—The circular summarises the available information on dry cells. A brief description of the materials and methods of construction and elementary theory of the operation of the cells is given. The various sizes and kinds of dry cells on the American market are described. The electrical characteristics of the cells and methods of testing them are discussed. In an appendix are given the proposed specifications for dry cells which have been prepared by the Bureau.

The British Engineering Standards Association has issued a list of British Standard Copper Conductors, an extract from the revision of British Standard Specification No. 7, for Insulated Annealed Copper Conductors for Electric Power and Light, which will shortly be available. It has been decided to issue this extract in order that immediate attention may be called to the reduction in the number of sizes, and the omission of a wire gauge as a means of designating the conductors. Copies of this pamphlet may be obtained gratis, or, post free, price 2d., from the Association.

"French Technical Words and Phrases." An English-French and French-English dictionary. By J. Topham. 324 pp. London: E. Marlborough & Co. Price 5s. 6d. net.

"Zooms and Spins." By Rafbird. Pp. viii + 120 and 1 fig. London: Sampson Low, Marston & Co., Ltd. Price 3s. 6d. nét.

"*Journal* of the Institution of Electrical Engineers." Vol. LVII. No. 281. April, 1919. London: E. & F. N. Spon. Price 7s. 6d. net.—This issue contains the following paper:—"The Determination of the Efficiency of the Turbo-Alternator," by Dr. S. F. Barclay and Dr. S. P. Smith; and the President's Address to the Territorial Centres; also Report of the Council for 1918-19 and the Annual and Benevolent Fund Accounts for 1918.

"*Journal* of the Röntgen Society." No. 59. Vol. XV. April, 1919. London: Percy Lund, Humphries & Co., Ltd. Price 4s. 6d. net.

**Catalogues and Lists.**—Automatic and Electric Furnaces, Ltd., 281-283, Gray's Inn Road, London, W.C. 1.—Two pamphlets—one describing the Wild-Barfield electric muffle furnaces, the other (Heat-Treatment Bulletin No. 10) dealing with "Salt Baths and 'Soft Skin'" heat-treatment of springs.

London Electric Stores, Fulwood House, High Holborn, W.C. 1.—Price list of accessories, small motors, bells and bell wire, and ironclad switchgear.

Quead, Ltd., 45, Marylebone Lane, W. 1.—Illustrated list of "Quead" electric fires, with interchangeable removable interiors, of capacities from 1 to 4 kw., and various patterns of case and finish.

Gent & Co., Ltd., Faraday Works, Leicester.—Pamphlet describing their "Start and Cease Work" sound signals, electrical escapements for time registers of all types, works electric clocks, office clocks, and impulse transmitters on the "Pulaynetic" system.

Wardle Engineering Co., Ltd., 196, Deansgate, Manchester.—Booklet on "Good Lighting," dealing with street and office lighting, and giving useful advice on the subject of illumination. An interesting description is included of the method adopted for lighting the clock tower of the Houses of Parliament with electricity in 1873.

## LIGHTING AND POWER NOTES.

**Accrington.** — Proposed Extensions. — The scheme sanctioned by the T.C. for extensions to the electricity works has been approved by the Board of Trade. It was on the ground that the extensions would not be sanctioned by the London Authority that the Corporation Committee postponed a proposal to increase by £100 per annum the salary of the borough electrical engineer, Mr. A. W. Clegg.

**Armagh.**—Proposed E.L. Scheme.—The U.D.C. Committee on Lighting has reported in favour of seeking competitive plans for an electric installation scheme, with a prize of £20, Mr. J. J. Woods, manager, Clones Electric Works, to be called into consultation when the plans are executed.

**Ayr.**—Expert Advice.—The Lighting Sub-Committee, after considering reports from its own engineer and the Kilmarnock town engineer, recommends the T.C. to employ an expert to report on the whole situation, present and prospective.

**Belfast.**—Extension Scheme.—The week before last we referred to the serious position in which the Corporation has been placed in regard to its scheme of extending the electricity undertaking. Following the report by Messrs. Preece, Cardew, Snell & Rider, the consulting engineers, the Corporation held a special meeting to consider the whole matter. The first sitting resolved itself into an attack by several members on Sir John Snell, who prepared the estimate, but a motion to terminate the agreement between the Corporation and Sir John Snell was defeated after a lively debate. At the second part of the sitting, Mr. Rider addressed the Council, and said that his partner, Sir John Snell, in whose place he appeared, was somewhat at a disadvantage, because he had had nothing to do with the original figures. That, however, did not make his responsibility any the less, and he did not wish to shirk it. He wished to take for Sir John and himself the responsibility, so far as they were justified in taking it, for the position in which the Corporation now found itself. He defied any man to make an estimate of to-day's price and guarantee that it would hold good for next week. The figures in his latest estimates were very pessimistic. They were putting in the minimum amount of plant, and it was for the Corporation to decide whether it would go on or not. If it did not go on, the position would be infinitely worse than it was that day. It was not a proper suggestion to make that the advice had been given for what the firm was to get out of it. They were not being paid upon the usual basis of expenditure. Sir John Snell's fee was about half the usual engineering fee. His advice was that they must go on and extend the station as quickly as possible. Alderman Sir James Jonston moved:—"That the Council be recommended to apply to the L.G.B. for sanction to a loan of £630,000 for an equated period of 30 years, in substitution of the sanction applied for in March, 1918, and to take such further steps as might be necessary." The resolution was adopted.

Holding that the Corporation was not legally responsible for having, through the strike, failed to carry out contracts for supplying electricity, the Belfast Stipendiary, on May 12th, dismissed a summons brought by a manufacturer.

**Bradford.**—New Mains.—Electric mains from the Valley Road works to the Manningham Mills of Messrs. Lister and Co., Ltd., are to be laid at a cost of £8,275.

**Continental.**—Portugal.—A scheme for the utilisation of the power of the River Zezere at the mines of the Wolfram Mining Co., has been prepared and will probably be carried into effect at an early date.

France.—A new company has lately been formed at Lyons with a capital of £50,000, and the title La Société Hydro-Electrique de la Bredoire, to establish plant to utilise the water power of certain falls on the River Tiers at La Bredoire (Savoy), to generate electricity for lighting and power purposes.

The blast furnaces and foundries at Pont-à-Mousson have projected a scheme for a hydro-electric station on the River Derdogne, near Bort. It will develop the falls of La Diège, a feeder of the Derdogne.

The scheme for utilising the River Rhône to supply Paris with electricity has now at last reached maturity by the adoption by the Paris Municipal Council of the Genissiat Falls project, after satisfaction of the claims of riverside dwellers which stood in the way. The city of Paris has disclaimed the intention of appropriating the whole of the waters of the Upper Rhône, and has made provision for irrigation and navigation. It will develop the falls, donate Lyons with a great port, and irrigate the Carnargue region. The outlay will probably reach 1½ milliards of francs, and Paris will gain 200,000 kw. of electrical power. The works are to be carried out by a national company comprising all the interests concerned, with the help of the State.

**Coventry.**—Price Revision.—The T.C. has decided that the charges for power as from January 1st, 1919, be increased by 20 per cent. over the charges in force on September 30th, 1918.

**Dundalk.**—Street Lighting Charges.—The Electricity Committee has notified the U.D.C. of an increase in the price of electricity for public lamps from 56s. 6d. to £3 each, as from July 1st, involving an increase of £114 in the estimate for the year. The engineer's estimate is to be considered in regard to a revision of the existing supply tariff generally.

**Dundee.**—Price Revision.—The charges for power and light have been revised, varying from 50 to 100 per cent., plus 5 per cent., over pre-war rates.

**Epsom.**—Proposed Price Increase.—The U.D.C. has applied to the B. of T. for consent to increase the minimum charge per quarter for energy from 18s. 4d. to £1, and the charge for each unit beyond 20 to 1s., instead of 8d.

**Farnworth.**—Year's Working.—The working of the U.D.C.'s electricity undertaking has resulted in a loss on the year of £278, but it is expected that the recent increase in the prices for electricity will remedy this during the current year. During the

year 1,087,563 units were generated, compared with 1,194,865 in the previous year. The total capital expenditure is £52,787, of which £29,900 has been repaid.

**Gillingham (Kent).**—Expert Advice.—The T.C. has engaged Mr. C. H. Wordingham to advice on the present state of the electricity undertaking, and on the policy in respect of it for the future, at a fee of £250.

**Hastings.**—Proposed E.L. Scheme.—Negotiations are proceeding between the Hastings Corporation and Battle U.D.C. regarding a scheme for supplying the latter town with electric light. The Hastings Corporation is prepared to bring a H.T. cable to a central spot in the Abbey town, and distribute at L.T. within a radius of one mile. The Council requires a guaranteed gross revenue of about £1,800 a year, Battle consumers to receive electricity for lighting and power on the same terms and conditions as Hastings consumers, the price to be 9½d. per unit, and 2½d. for power, heating, and cooking, to be in force for two years from the termination of the war, after which time the maximum charge would be 8d. The Battle Council is to canvass the town to ascertain the number of consumers likely to be forthcoming.

**Hull.**—Proposed Extensions.—The Electricity Committee has adopted the scheme for extensions to the electricity undertaking, estimated to cost £123,720.

**Kilmallock.**—Lighting Costs.—At the request of the Kilmallock E.L. & P. Co., the U.D.C. is to contribute £114 yearly towards the costs and expenses of upkeep to the public lighting system.

**London.**—Hackney.—The Electricity Committee recommends that it be authorised to supply consumers with electricity for illumination purposes during the four days of the Peace Celebrations at a special rate of £1 per KW. connected, such supplies to be connected to the mains without meters.

**Maidenhead.**—House Services.—The T.C. has decided in future to give new consumers requiring less than 33 ft. of cable the option of paying the whole cost of the service, or a lump sum of £2 and a minimum charge of 15s. 4d. per quarter. Hitherto up to 30 ft. of cable inside premises nearest to the main has been laid free of charge.

**Manchester.**—Year's Working.—The loss on the past year's working was caused by a reduction in sales of energy since the Armistice. It was anticipated that, in order to pay the contribution of £33,400 in aid of rates, it would be necessary to draw £11,000 from the reserve fund. The account shows, however, that the reserve fund has been exhausted by withdrawing £12,636 more than was anticipated, that a loss of £14,254 is carried forward, and that no contribution can be paid in aid of rates, against the sum due of £33,400. This shows a total of £60,290 worse than was anticipated, and a loss of £71,290 for the year. In the estimates for the current year the receipts are put at £1,109,000, an increase of £160,100. The expenses are estimated to be more by £138,500, made up of £116,000 for operating charges, £16,500 for debt charges, and £6,000 for income-tax. The surplus is estimated to be £44,000, of which £14,254 is required to liquidate the debit balance brought forward, leaving £29,746 in aid of rates. The amount due, however, in accordance with the decision of the Council at 1 per cent. upon the capital outlay is two years' contributions—namely, £67,893—so that there is an estimated deficiency of £38,147.

**Malvern.**—Consumers' Rebate.—The U.D.C. has decided that, from the midsummer reading of the meters, consumers above 5,000 units per annum shall be allowed a rebate of 1d. per unit. A canvass of the West Malvern district having proved unsatisfactory, the Council has decided not to extend the mains there, the estimated outlay for which was £4,000.

**Nenagh (Tipperary).**—E.L. Scheme.—The Nenagh (Co. Tipperary) Gas Consumers' Co. is arranging to install electric lighting plant to light the town.

**Normanton.**—Proposed E.L. Scheme.—The U.D.C. is to consider the question of an electric lighting scheme.

**Richmond (Surrey).**—E.L. Charges.—The T.C. did not show favour to a suggestion by the Richmond (Surrey) E. L. and P. Co. that the terms of agreement between the two bodies be revised and a further increase be made in charges to meet expenses due to the war.

The Electricity Committee did not concur in the proposal to grant plenary powers to the representatives of the I.M.E.A. acting on the Joint Industrial Council—Electricity Supply Industry—and to authorise their exercising such powers when negotiating outside the Industrial Council with any body of workers or association not having representation thereon.

Electric Vehicles.—The Health Committee recommends that the tender of the Lancashire Dynamo and Motor Co., amounting to £493, for apparatus capable of charging two electric vehicles at a time, be accepted.

**Sheffield.**—Price Revision.—The charges for electricity are to be increased as from the June meter readings as follows:—Units charged over 2d. are to be subject to an increase of 25 per cent. instead of 10 per cent., as at present; units charged 2d. and under subject to an increase of 60 per cent. instead of 45 per cent.

**South Africa.**—Mossel Bay (Cape Province).—The T.C. has given favourable consideration to a scheme for electric lighting which has been put before it by Lieut.-Colonel McKienery, an electrical engineer, on behalf of a syndicate. The company is prepared to commence operations 30 days after the scheme is adopted, and to deposit £5,000 as security. The term suggested for the contract is 21 years, the Council having the option of acquiring the installation at the end of 7, 14, or 21 years.

Johannesburg.—The municipal strike was settled on the following principal terms, viz.:—The Board of Control ceases to exist; no men to be retrenched; Advisory Committees of employés to be elected by the men for the purpose of advising on, and discussing with, the management and Committees all questions relating to wages and conditions of labour. Employment and paying off of men should rest with the respective heads of departments in consultation with the Advisory Committees to be appointed.

**Stafford.**—Proposed Extensions.—The T.C. has approved a proposal that the capacity of the electricity works be increased by the installation of a 1,000-KW. set, and that a Sterling boiler, with the necessary buildings, be provided at a total estimated cost of £30,000.

Year's Working.—The annual report on the electricity undertaking shows total income of £14,362, an increase of £2,296, and total expenditure, £9,891, an increase of £2,368. After providing £1,000 for depreciation, there remained a balance of £3,470, a decrease of £72. The total net income was £3,548; war charges and income-tax amounted to £4,110, so that the net result was a deficiency of £562.

**Stamford.**—Price Revision.—The Urban E.S. Co. has decided to apply to the B. of T. for permission to amend its charges, and substitute a maximum charge of 8d. per unit.

**Swansea.**—Loan Sanction.—The Electricity Committee reported that L.G.B. sanction had been granted for the borrowing of £25,690 for additional plant at the generating station.

**Walsall.**—Electricity Scheme.—The Standing Orders Committee of the House of Lords has rejected the electricity clauses of the Corporation Bill, the objects of which were to provide an electricity scheme for a wider area.

**West Hartlepool.**—Proposed New Plant.—The T.C. has approved of application being made to the L.G.B. for sanction to borrow £23,580 for cooling-tower plant and £10,790 for cables. Over 12 months ago the Council sanctioned an agreement with the Cleveland Power Co. under which an additional, as well as a standing, supply of energy was to be obtained from the company, it, on the other hand, taking from Council energy generated by waste heat at periods of low demand.

**Worcester.**—Proposed New Plant.—The Electricity Committee has brought forward a programme of necessary developments of the electricity undertaking, and has asked the Council for authority to borrow £15,350 for ash handling plant, cables, services, switchgear, and transformers. The matter was adjourned until after the electricity accounts had been submitted. It was stated that increases to the staff and workmen would entail additional expenditure of £3,500 per annum. The Council approved of recommendations increasing the charges for electricity, and it was stated that in all future contracts a labour clause would be inserted.

## TRAMWAY AND RAILWAY NOTES.

**Birmingham.**—Borrowing Powers.—The Corporation has deposited a petition in Parliament asking that the necessary Standing Orders be dispensed with in order to enable it to introduce a late Bill for powers to borrow £659,667. The whole of this money is proposed to be expended on the Corporation's tramway undertaking.

**Bournemouth.**—Year's Working.—During the past year the Corporation tramways carried 20,769,507 passengers, an increase of 315,000 on the previous year. The total receipts increased by £17,123, and working expenses totalled £73,730, an increase of £11,080. The net balance on the year's working was £31,950. The Tramways Committee recommends that £1,000 be transferred to the working balance, and the remainder to the renewals fund, which will now stand at £66,200, the reserve fund at £6,300, and the working balance at £9,500. The tramway manager reports that the generating station, rolling stock, and overhead equipment have been well maintained. The permanent way in some areas was more than five years overdue for relaying. The total amount of war bonuses and allowances paid was £21,220.

Experiments with the Sorbitic treatment of rails are being carried out on a portion of the permanent way.

**Bristol.**—Electric Vehicles.—The city engineer, in consultation with the city electrical engineer, recommends that six electric lorries be purchased for the purposes of the Sanitary Committee.

**Canada.**—STRIKE.—Tramway and railway employés have joined the general strike at Winnipeg, in which several Unions in Canada are concerned, demanding reductions in hours, and increases in wages.

**Continental.**—FRANCE.—The estimated cost of the electrification of the Midi Railway network, based on official observations in the Pyrenees and neighbouring regions, is put at 60,000,000 fr. A group of hydro-electric stations, with a 100,000-H.P. equipment and a storage lake of 16,000,000 cb. m., are among the features of the scheme.

The Compagnie des Tramways Electriques de Marseilles is in danger of winding up, in consequence of the war and the general high cost of materials, salaries, &c. In the last resort, application has been made to the Government for assistance.

**Coventry.**—PROPOSED FARE INCREASE.—The T.C. has applied to the B. of T. for powers to increase fares from 1d. a mile to 1½d. for each existing 1d. stage, which at present averages 1·25 miles. The Warwickshire County Council has represented to the Board that no fare increase should be sanctioned until the tramways have been relaid, and unless a fair payment is made for the use of the main roads.

PROPOSED LIGHT RAILWAY.—The Warwickshire C.C. has been asked to prepare a scheme for an electric light-railway or motor service from Warwick to Shipton-on-Stour and other places around Stratford-on-Avon. The scheme has been deferred pending the passing of the Ways and Communications Bill.

**Glasgow.**—PROPOSED KEARNEY RAILWAY.—We understand that a scheme has been prepared, and placed before the Lord Provost and City Council, for the installation of the Kearney High-Speed Railway Co.'s tube system in the Glasgow Harbour tunnel under the river Clyde, about one mile below Glasgow Bridge, connecting Finnieston and Mavisbank, and, according to *Modern Transport*, it is confidently anticipated that the proposal will meet with early acceptance.

It is proposed to run one car to and fro; the car would seat 40 passengers, and as the tunnel has a rising gradient of 1 in 3 at each end, it would operate mainly on the switchback principle, with assistance from electric power. A journey each way would be made in two minutes. The Brush Electrical Engineering Co., Ltd., would provide the equipment.

**Hebburn-on-Tyne.**—LINKING-UP.—At a meeting of the U.D.C. it was decided that steps be taken to link-up the Gateshead and Jarrow tramway systems, and a deputation appointed to interview the Gateshead and District Electric Tramways Co.

**Hull.**—TRAMWAY COMMITTEE.—The T.C. at a special meeting last week, asked all members of the Corporation Tramways Committee to resign. Another Committee of 14 members was elected to take over the management and control of the tramways. Some of the old members of the Committee were re-elected. Mr. W. J. Mycombe, tramway manager, recently resigned, following an inquiry into the management of the undertaking.

**Keighley.**—RAILLESS SYSTEM.—An application for consent to run 'buses on the railless trolley route between Keighley and Oxenhope has been made to the West Riding County Council, but the W.R. Highways Committee recommends that consent be withheld, on the ground that the demand for road making material is greatly in excess of the supply. The scheme was approved in 1916. Keighley's immediate right of appeal to the L.G.B. was waived at that time for the period of the war. Power to run railless trolley cars on the route was obtained six years ago, and the overhead equipment has been standing for the past three years.

**Liverpool.**—FARE REVISION.—The T.C. has decided to increase the tramway fares on the basis of 1½ miles for 1d. The reduction in the hours of labour would mean an increase of £160,000 on the wages bill.

**London.**—L.C.C.—The Highways Committee reports that it has arranged for the payment to the British Westinghouse Co., Ltd., of the bonus of £1,500 on steam consumption under the terms of its contract in respect of each of the two turbo-generators erected by the company at the Greenwich power station.

The Committee has distributed among employés in the tramway department a coal-saving bonus of £1,614 and £1,077 for the quarters ended September 25th and December 25th respectively.

The average number of tramway cars in use is 1,174 and 114 trailers, but it is anticipated that by the end of this month 70 additional cars will be in use, and steps are being taken to place a further 100 cars in service. At a meeting of the Highways Committee, last week, the chairman stated that owing to the through running services the increased fares could not have been put in operation at the same time in the North and South London areas. As far as possible, well-known traffic points were used as fare stages, so that many of the old stages were retained. An average length of stage of 0·75 mile was being adhered to as closely as possible. Under existing conditions the reintroduction of 1½d. and 2½d. fares could not be advised.

The case of the L.C.C. tramways was explained last week to the London M.P.'s who are interesting themselves in the traffic problem. The chairman of the Highways Committee said that the number of passengers carried last year was 636 millions, an increase of 224 millions over 1909, and the working expenses had risen from 6½d. per car-mile in 1914 to an estimated figure of 1s. 4d. now. The net debt on the tramways was £8,477,000, and the capital commitments totalled £1,600,000. Mr. A. L. C. Fell, general manager of the tramways, said that the extensions between Farringdon Street and Blackfriars, and Gray's Inn Road and Holborn would considerably relieve the congestion at Blackfriars. The increase in fares was not permanent and depended on the cost of labour and materials.

The general manager of the Metropolitan Railway Co. said that his company, which was entirely independent of the Underground combine, had 88 miles of line, 36 of which were electrified. The average return to stockholders last year was 2·03 per cent. In 1913 passengers totalled 115 millions, in 1918 145 millions, and this year (based on the first three months) would number 170 millions. The expenses had grown from £398,000 in 1913 to £707,000 now, a 129 per cent. increase. Statements concerning the new type of six-car train expected by the company to be running on the Inner Circle in August, were made. The new train would, it was expected, complete its station work in less than 25 sec. Each car is to be fitted with five doors on either side, which, instead of sliding will swing outwards. The movement of the train will automatically close them, when they will be held by a safety latch. The cars will be 53 ft. long, and by eliminating the vestibule at either end, and by re-arranging the seats, they will carry 58 instead of 48 persons. Most cars will have cross seats for two persons, and round the entrances single seats are being placed. Strap-hanging will be obviated by placing at the end of the seats, bars against which passengers can lean. An experimental train of this type is now under construction at Birmingham. The construction of deep-level express tubes under the existing lines is said to be under consideration.

POST OFFICE TUBE RAILWAY.—The B. of T. has extended the time for the completion of the railways authorised by the P.O. (London) Railway Act, 1913, for one year from August 15th, 1919.

HALFPENNY FARES.—M.P.'s for Ealing, Acton, and Hammersmith, have been petitioned to press tramway and omnibus companies to restore halfpenny intermediate fares.

ACCIDENTS.—A collision between a tramway-car and a steam tractor occurred last week at the foot of the gradient in Acton market place. The driver was unable to prevent the collision, which completely wrecked the front of the car, carrying away the staircase. No passengers were injured, but traffic was delayed while the line was being cleared.

Owing to the bursting of a water-main at Newington Butts, which forced the wooden blocks and flooded the roadway, there was considerable dislocation of the Tooting, Merton, and Norbury tramway service on Wednesday last week. The service between the Elephant and Castle and Kennington Gate had to be suspended.

The increased fares on the North London C.C. tramways came into general use on Monday last. Some of the fares are now nearly three times the pre-war rate.

**Manchester.**—CAR SHORTAGE.—In reply to complaints as to the Corporation tramway service, the general manager points out that the services cannot be improved owing to the shortage of cars. The construction of new vehicles is being pushed forward as rapidly as possible, but in addition to the complete suspension of building during the war, there are over a million more people travelling each week than in pre-war days. When the Committee started to build its own vehicles, the manager states, no contracts were sent out, but, in order to improve the services, contract for new cars have been given to Preston.

**Northampton.**—ELECTRICITY SUPPLY.—The T.C. has accepted the offer of the Electric Light and Power Co. to supply energy for the working of the Corporation tramways for a period of five years at 1·4d. per unit if the consumption is 1½ million units per annum, and at 1·33d. per unit for 1½ million units and upwards. The chairman of the Tramways Committee said that owing to deterioration of plant the cost of energy generated at the municipal power station had become excessively high, and to continue its use would involve a loss of at least £2,921 per annum. This amount could be saved if the company's offer was accepted, and could be further increased if the existing plant was sold and the station used for other purposes.

## TELEGRAPH AND TELEPHONE NOTES.

**Australia.**—It is expected that the Malvern telephone exchange will be transferred to the automatic system at the end of April. Installation of the automatic apparatus is almost complete. The plant is constructed on the Strowger system, which has been installed in the Brighton exchange and in 11 exchanges in Sydney and one each in Perth and Geelong. The next district to be placed under the automatic system will be Collingwood. Three thousand six hundred lines have been installed at Malvern, and the capacity of the plant is 10,000. Ultimately this exchange will be fitted in with a complete automatic network in the metropolitan area.

**Automatic Telephones.**—The Sheffield Chamber of Commerce has several times addressed itself to the inadequacy of the telephone system, and demanded the modernising of the system. A meeting of the Telephone and Telegraph Advisory Committee was held recently, which was attended by Sir Andrew Ogilvie, Second Secretary of the P.O., the Superintending Engineer, the Local Engineer, the District Manager of Telephones, the Postmaster of Sheffield, and a representative of H.M. Office of Works.

Sir Andrew definitely pledged his department to install a complete automatic telephone exchange system as well as several new exchanges. The scheme will necessitate a new central exchange, and two new sub-exchanges, in addition to three existing exchanges in which there is accommodation for an automatic system. Negotiations are in progress for sites, and it is hoped to place contracts for the buildings immediately. It is estimated that it will take three years to complete the automatic system. Sir Andrew admitted that the present telephone exchange is out of date, and in a bad condition.

The Post Office expects that the observations of the working of automatic telephones in American towns by telephone experts to be sent to the U.S. should be of great service in connection with the adoption of the system in London.

**Cable Delays.**—The Pacific Cable Board announce that, owing to the heavy pressure of telegrams to Australasia, the total telegraphic traffic is in excess of the carrying capacity of the Pacific cable, which is at the present moment the only route available. There is now a delay of approximately seven days on messages for Australasia.

There are breakdowns on the Eastern Telegraph Co.'s lines, which are closed to Australasia messages. The only route available is through the Pacific Cable to Canada, and overland to Vancouver. The Pacific Cable is dealing with 14,000 words a day—three times the pre-war traffic. Messages to the Far East are delayed 12 or 13 days.

**Canada.**—Telephone and telegraph operators have joined the general strike at Winnipeg, in which several Unions in Canada are concerned, demanding reductions in hours and increases in wages.

**Telephone Irregularities.**—In reply to a question in the House, the Postmaster-General said that records showed that in London the cases of irregular interruption in telephone calls averaged slightly over six per 1,000 calls during the last six months. These figures include cut-offs due to line and apparatus faults, as well as those caused by operators.

Stores provided for war purposes and now available for other purposes will be utilised in all cases in which they are found to be suitable for ordinary telephone work.

**Wireless Telegraphy.**—During the Atlantic flight from Newfoundland to the Azores, the wireless apparatus on board the American aeroplane N.C. 4 is said to have worked marvellously well. Messages were received over 1,300 miles and transmitted over 730 miles. Destroyers were in constant communication with the aeroplanes by wireless.

**Wireless Telephony.**—An R.A.F. aeroplane, carrying passengers and mails, flew last week from Kenley, near Croydon, to Paris, at night, in 4 hours 15 minutes. For the first 80 miles—that is, until the machine was well over the Channel—the commander of the squadron at Kenley was in constant telephonic communication with the aeroplane. The speech was said to be so clear that when the receiver was laid on the table in the wireless room, the voice of the pilot could be plainly heard by persons outside the door. The ground staff at Kenley overheard the pilot speaking to the aerodrome at Lympne, on the Kentish Coast, and later he was heard speaking to Marquise, on the Flanders Coast. This is noteworthy, as the instruments are said to have been designed for a range of 35 miles only, whereas conversation was actually carried out over distances between 80 and 90 miles.

# CONTRACTS OPEN AND CLOSED.

*(The date given in parentheses at the end of the paragraph indicates the issue of the* ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

## OPEN.

**Australia.**—BRISBANE.—June 18th. Brisbane City Electric Light Co. Supply of rotary converters (specification 10s. 6d.). Offices of the company at Brisbane.—*Tenders.*

SYDNEY.—June 9th. City Council. Supply and erection of power-house switchgear. Specifications from Electric Lighting Department, Town Hall, Sydney.*

June 23rd. Municipal Council. One 60-ton electrically-driven overhead travelling crane. Electric Lighting Department, Town Hall, Sydney.*

**Bray.**—June 3rd. U.D.C. Electricity Department. One 200-B.H.P. Diesel engine, direct coupled to 135-K.V.A. single-phase alternator and exciter. (See this issue.)

**Bury.**—June 6th. Electricity Department. One 6,000-KW. steam turbo-alternator and exciter, with surface condenser and air circulating pumps. (May 16th.)

**Heywood.**—June 11th. Electricity Committee. One 400-KW. rotary converter, transformer, with switchgear and cable work; 1,500 yd. ·15 sq. in. E.H.T. cable; 1,500 yd. ·05 sq. in. E.H.T. cable; 1,000 yd. of ·10 sq. in., ·05 sq. in., and ·10 sq. in. E.H.T. cable. (See this issue.)

**Ilford.**—U.D.C. Electricity Department. Supply of 350 yd. L.T. rubber-insulated, and 75 yd. E.H.T., 3-core, paper-insulated, lead-covered cable. (See this issue.)

**London.**—L.C.C. May 27th. Tramways Department. 2,000 tons of standard steel girder tramway track rails with fastenings, and alternatively, about 4,000 tons of standard track rails, lipless track rails and renewable guard rails. Specification (£2) from the Chief Engineer, County Hall, Spring Gardens.

**Manchester.**—May 28th. Electricity Committee. Two 4,000-K.V.A., three-phase static transformers for Stuart Street generating station. Mr. F. K. Hughes, Secretary, Electricity Department, Town Hall.

June 4th. Electricity Committee. Supply of cable for 12 months. (May 16th.)

**New Zealand.**—June 4th. Public Works Department. 1¼ miles of 11,000-volt cable.*

**Oldham.**—May 27th. Tramways Department. 12 double-deck top covered tramcars, with or without vestibules, complete with trucks; also 12 complete 40-H.P. electrical equipments for the above. (May 16th.)

**Tasmania.**—LAUNCESTON.—July 28th. City Council. Sub-station equipment, battery, reversible booster, switchgear, &c. City Electrical Engineer.

**Warrington.**—June 4th. Electricity Department. H.T. and L.T. lead-covered cable, motors and transformers. (See this issue.)

*A copy can be seen at the Inquiry Office of the Department of Overseas Trade (Development & Intelligence), London.

## CLOSED.

**Australia.**—P.M.G.'s Department, Victoria :—
Automatic telephone equipment for the Perth Automatic Exchange, £119.—Automatic Telephones (Aust.), Ltd.

P.M.G.'s Department, N.S.W. :—
Telephone accessories, £422.—Western Electric Co. (Aust.), Ltd.
1,000 earpieces, 200,000 insulated staples, £82.—Laurence & Hanson Electrical Co., Ltd.
2,500 earthclips for water pipe, £177.—Royal Australian Navy Wireless Works.

Victorian Railways :—
Electric lamps, 110-volt, 20-watt, 2s. each; 40-watt, 2s. each.—Australian General Electric Co.
—*Tenders.*

**Croydon.**—T.C. :—
Alterations and extensions to tramcar inspection pit, Thornton Heath.—G. E. Everitt & Sons, Ltd., £570.

**Isle of Thanet.**—Joint Hospital Board :—
Maintenance of electric bells and telephones at Haine Hospital.—E. Coveney, Ramsgate, £12 a year.

**Rotherham.**—T.C. :—
Four double-deck tramcars.—Dick, Kerr & Co., Ltd., £2,190 each; 12 new bodies, without tops.—Dick, Kerr & Co., Ltd., £1,705 each.

**Sunderland.**—T.C. Accepted :—
L.T. feeder and service cables.—B. I. & Helsby Cables, Ltd.
Vertical boiler.—W. Woodhead.

**Taunton.**—Electricity Committee :—
500-KW. turbo set, complete with pipework, auxiliaries and accessories.—Messrs. C. A. Parsons & Co., £11,085.
5-ton travelling crane and gantry.—Messrs. Herbert Morris & Co., Ltd., £557.

## FORTHCOMING EVENTS.

**Royal Society of Arts.**—Monday, May 26th. At 4.30 p.m. At John Street, Adelphi, W.C. Paper on "A New Prime Mover of High Efficiency and British Origin," by Capt. F. E. D. Acland, R.A.

Tuesday, May 27th. At 4.30 p.m. At John Street, Adelphi, W.C. Paper on "Science and Industry in Australia," by Lt.-Col. the Hon. Sir John McCall, Agent-General for Tasmania.

Wednesday, May 28th. At 4.30 p.m. Paper on "Glass Making Before the War," by Mr. H. J. Powell.

**Provincial Electric Supply Committee of the United Kingdom.**—Tuesday, May 27th. At 2.30 p.m. At the Holborn Restaurant. Annual meeting.

**Royal Institution of Great Britain.**—Tuesday, May 27th. At 3 p.m. At Albemarle Street, W. Lecture on "Listening Under Water," by Prof. W. H. Bragg, C.B.E., F.R.S.

**Industrial Reconstruction Council.**—Tuesday, May 27th. At the Institute of Journalists, Tudor Street, E.C. At 5.30 p.m. Discussion on "The Relation of Welfare Work to Scientific Management," to be opened by Miss Voysey.

Wednesday, May 28th. At 4.30 p.m. At the Saddlers' Hall, Cheapside, E.C. Lecture on "The Only Way to Higher Wages and Shorter Hours," by the Rt. Hon. Lord Leverhulme.

**Institution of Electrical Engineers.**—Tuesday, May 27th. At 6.30 p.m. At Caxton Hall, Westminster. Joint meeting with the Electrical Contractors' Association and the Association of Supervising Electricians. Discussion on "The Electrical and Engineering Equipment of Modern Small Houses."

Thursday, May 29th. At 2.30 p.m. At the Royal Society of Arts, John Street, Adelphi. Annual general meeting.

**Institution of Mechanical Engineers.**—Friday, May 30th. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. Resumed discussion on "The Mechanical Properties of Steel, with some Consideration of the question of Brittleness."

**Illuminating Engineering Society.**—Friday, May 30th. At 8 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Discussion on "The Gas-filled Lamp and its Effect on Illuminating Engineering," to be opened by Mr. F. W. Willcox.

**London County Council.**—Friday, May 30th. At 4 p.m. At the County Hall, Spring Gardens, S.W. Conference on "The Report of the Committee Appointed to Inquire into the Position of Natural Science in the Educational System of Great Britain."

## NOTES.

**Single-Phase Squirrel-cage Motor with Unity Power Factor.**—Test results are given (*Electrical Review*, Chicago) of a ½-H.P. single-phase squirrel-cage motor operating at unity power factor. The motor has a two-phase winding, one winding being connected across the line, and the other across the line in series with a condenser of suitable capacity. The adjustment is made so that the current in one winding lags 45° behind the line voltage, and that in the other winding leads 45° in front of the line voltage. The motor is self-starting, has an efficiency of 49 per cent., a starting torque of 55 per cent., and a pull-out torque of 240 per cent. The effect of inserting condensers of various magnitudes is shown in a series of curves in the original article.

**A. L. & N.W. Special Train.**—A special train designed and built at the London and North-Western Railway Carriage Works at Wolverton two years ago, to provide living accommodation for the Commander-in-Chief of the British Army and his staff in France, was described in a recent issue of the *Railway Gazette*. On April 10th, 1917, the company was asked to provide a train of ten vehicles for the purpose referred to above. Five of them left the works on May 5th, and the remaining five on the 12th of the same month, so that the complete train was provided in a month from the date of order. A further request for four additional vehicles was received later, and these were fitted up and sent out on July 20th, 1917. The fitting up and dispatch of a complete train of this description in the short period of time named reflects considerable credit on the company's works organisation. In the kitchen car accommodation is found for the electric lighting plant and the accumulators. A whole coach is utilised as a telegraph and telephone vehicle. The train is electrically lighted by a petrol-driven set, is steam heated by the locomotive when running, and by a boiler fitted in the brake and stores car when standing. The telegraph and telephone car was fitted up with the necessary instruments by the engineering staff of the G.P.O. There is a telephone and bell communication throughout the train, and means are provided and cable carried on the telephone car for connecting up to any telegraph or telephone system in proximity to the train. There is an ample supply of fans and roof ventilators, while all the drop lights are fitted with louvres and gauze with which they can be screened.

**Institution and Lecture Notes.—Institution of Electrical Engineers.**—On Wednesday last week a lecture on the development of wireless telephony by the Royal Air Force during the war was delivered by Major J. Erskine-Murray, R.A.F., before a crowded audience, with the aid of lantern slides and a large collection of apparatus. The lecturer first outlined the great expansion of the art which had taken place since the outbreak of war, showing the intricacy of the measurements and calculations which were involved, and illustrated the difference between the trains of waves produced by the spark discharge, and the continuous-wave system, and various "tonic trains" of waves. He then explained the operation of the transmitters depending for their operation on the valve amplifiers, and demonstrated with the help of apparatus the method of direction-finding, or position-fixing, which had been evolved by the Air Force for use on aircraft, enabling direction to be determined to an accuracy of one or two degrees. With the help of this system an airman can find his way anywhere with certainty, though the atmosphere may be too misty for him to see the ground at all.

The most striking feature of the lecture was the actual reception of wireless telephone messages from an airman in a Nieuport aeroplane, who was cruising about over London for that purpose; by means of powerful amplifying apparatus, the voice of the airman was made audible throughout the large lecture room of the Institution of Civil Engineers, and though articulation suffered owing to the immense degree of magnification employed, his remarks were clearly intelligible. A member of the staff of Major Erskine-Murray spoke to the airman from the lecture room, and informed him that the audience were going to award him a vote of thanks, which they did most heartily; the airman said he heard the clapping, and thanked the meeting. The demonstration was perfectly successful, and of a very striking and impressive character.

On account of Senatore Marconi having to return to Italy in connection with his military duties, the meeting which was to have been held on Tuesday, June 3rd, has been cancelled.

Captain L. B. Turner's paper on "The Oscillatory Valve Relay: a Thermionic Trigger Device," will be read and discussed on Monday, June 30th (instead of Thursday, June 26th).

The annual general meeting of Members, Associate Members and Associates only, will be held at the Royal Society of Arts, John Street, Adelphi, W.C., on Thursday, May 29th, at 2.30 p.m., to receive and consider the accounts for the year ended December 31st, 1918, and the annual report of the Council, and to elect auditors.

On the conclusion of the above meeting there will be held the annual general meeting of the contributors to the Benevolent Fund, to receive the report of the Committee of Management, and the statement of accounts and balance-sheet to December 31st, 1918.

The annual meeting of the North-Eastern Centre was held at Newcastle-upon-Tyne, on May 12th, Mr. A. P. Pyne presiding. The report states that the total membership had increased by 33. A large and varied programme had been dealt with, but visits to orks had been difficult to arrange. The attendance at meetings was improving. On the occasion of the president's visit the scheme of reorganising the Institution, with a view to founding a Chartered Institute, was laid before the members. The Tees-side Sub-Section had held six meetings, and one joint meeting with the Parent Section. It had not been possible to hold meetings of the Students' Section. This Centre had been entrusted with the formation of a Research Sub-Committee to deal with the question of the heating of buried H.T. armoured cables. The Sub-Committee had held several meetings, and made one report; further useful work was still in progress. During the session the question of National Electric Power Supply had been constantly under review by the Committee. It was deemed advisable to take strong exception to the letter sent by the B. of T. Reports Joint Committee, setting out the views of the Committee, and conveying the impression that these views were those of the Institution as a whole. Representations made by the Committee to the Council in this connection had been given effect to, and machinery set in motion to obtain the views of the Institution as a whole prior to further action on the part of the Council. The officers were elected as follows:—Chairman: Mr. W. Cross. Vice-Chairmen: Messrs. J. R. Andrews and J. R. Beard. Past Chairmen: Messrs. A. P. Pyne, A. H. Marshall, H. W. Clothier. Committee: Power Supply Undertakings, Messrs. E. Fawssett, R. M. Longman, G. L. Porter, J. W. Jackson, W. F. T. Pinkney, C. Vernier; Manufacturers and Contractors, Messrs. L. H. A. Carr, A. Collins, T. Carter, A. H. Law, J. Rosen; Universities and Technical Colleges, Dr. W. M. Thornton; Consulting Engineers, Mr. R. W. Gregory; Borough Electrical Engineers, Mr. H. S. Ellis; Civil Service and Railways, Messrs. H. Kitchen, C. E. Taylor; Miscellaneous Sections, Dr. A. C. Michie. Hon. Treasurer: Mr. W. T. MacCall. Hon. Secretary: Mr. L. H. A. Carr. Tees-side Assistant Hon. Secretary: Mr. P. S. Thompson. Hon. Auditors: Messrs. C. Turnbull and F. G. C. Baldwin. The accounts showed a balance in hand of £27, while £32 remained to the credit of the Section in the hands of headquarters.

A lecture on "Dielectrics in Electric Fields" was then given by Mr. G. L. Addenbrooke.

**Electrical Power Engineers' Association.**—A meeting was held at Derby on the 19th inst., and a proposal to form a Derby and district section of the Midland Division was carried unanimously, a temporary Committee being elected. The officers are:—Chairman, Mr. G. H. Lake, Derby; vice-chairman, Mr. Melbourne, Burton; secretary, Mr. P. Gordon Hicatt, Derby; treasurer, Mr. S. W. C. Bradley, Spondon. The Secretary's address is 9, Lorne Street, Derby.

**British Engineering Standards Association.**—Conference on Limit Gauges for Plain Cylindrical Work.—A conference on the question of limit gauges for general engineering work was held recently by the British Engineering Standards Association at the Institution of Civil Engineers, at which Sir Richard Glazebrook presided. The paramount necessity, from a national point of view, of a standard system of such gauges has been emphasised by the experience of the war. Repetition work is absolutely necessary, and if the manufacturers of the country can be persuaded to adopt a system of limit gauging, not only will the character of their work be improved, but their output will be increased.

During the discussion stress was laid on the necessity for publicity and educational work, and on the importance of securing that any system recommended should be a development of, and not incompatible with, the systems at present in use in the various factories. It was agreed that the hole should be the basis, and that the minimum dimension of the hole should be the nominal size, the tolerances being positive. The general feeling was that four or five qualities of work would be sufficient, and three classes of fit would be needed, *i.e.*, running fits, transition fits, and interference fits.

As regards the basis for laying down tolerances and allowances for running and transition fits, the feeling was expressed that the formula: Allowance $= a + b\sqrt{D}$, $a$ and $b$ being suitable constants and D the diameter, might be accepted provisionally. In applying such a law the tolerance would naturally increase by a series of steps, and it was generally agreed that for most qualities of work the steps should be limited to multiples of two or four 10 thousandths of an inch. Interference or obstruction fits should increase proportionally to the diameter.

A scheme by which, pending the formation of a Sectional Committee, the present Sub-Committee should be reorganised, with the addition of a number of manufacturing engineers, and given the power to appoint panel or small committees of experts to commence the detailed work, has been sanctioned by the Main Committee of the Association, and is being put into operation.

**Appointments Vacant.**—Engineer for the Hong-Kong Tramways Co.'s power station; commencing salary $400 per month (Hong-Kong currency) + $80 per month house allowance; lecturer in electrical engineering (£350, rising to £400), for the University of Bristol; instructor (£4) in electrical installation for training discharged Service men at the Kingston-on-Thames Technical Institute; foreman mechanician (£250 + £50), for the Federal Malay States Post and Telegraph Department; meter tester (75s.), for the Borough of Salford Electricity Department; Head of the Engineering Department (£300), Assistant in Mechanical Engineering (£250); Assistant in Electrical Engineering (£250), for the St. Helens Municipal Technical School; Engineering Assistant (£400), for the Electrical Engineers' Department, Stoke-on-Trent. See our advertisement pages to-day.

**Nitrogen Fixation in Germany.**—The factory of Chortzow Kattowitz, Bayr, Reichstickstoffwerke was built towards the end of 1914, and commenced working in 1915. In February, 1918, three furnaces were in working order and in constant use, a fourth was completed but not working, and four more were being constructed. Each furnace turns out on an average 20 tons of carbide in each shift of eight hours. The factory is the only one in that district, and was erected solely for the manufacture of nitrogen—chiefly for munitions, the waste (stickstoffabfall) being used as a fertiliser. State aid was given in the form of special machinery and exempted labour. The electric-arc process is used. The gases from the furnace are simply drawn off by draught ventilators fixed at the side of the furnace, and there seems to be no arrangement for rapidly cooling them by artificial means. Limestone and coke are used as absorption agents. The works own land on which the fertiliser is used, where vegetables, cereals, &c., are cultivated; no one particular crop is particularly favoured. The furnace is oval in shape and open at the top about 10 ft. high surrounded by a scaffolding for feeding. It is lined with a metal which can withstand extreme heat, next a lining of steel, then comes the water-cooling chamber, enclosed in fire-brick, finally an exterior steel casing. It is lined at the bottom with carbon blocks, which form one of the poles. The electrodes are at the top fixed on cranes, and can be raised and lowered.

**Electricity Supply in Australia.**—Following on the report of a committee of experts and the passing of the Electricity Commissioners Act last session, the Government has appointed the Electricity Commission, which consists of Mr. G. Swinburne, Prof. T. R. Lyle, and Mr. A. M'Kinstry. The commission does not include any member of the expert committee. The Premier stated that the Cabinet considered that the position was not sufficiently advanced in Victoria to warrant, at the present stage, the appointment of whole-time commissioners. The duties of these commissioners will consist of the investigation and pushing forward of the Morwell brown-coal scheme, the Kiewa River and other appropriate water schemes, and of framing regulations, by-laws, &c., as to the difficult and complicated problems relating to the standardisation, co-ordination, and interconnection of electrical undertakings in the State. The commissioners will be asked to select the best available hydraulic engineer in Victoria for the purpose of thoroughly investigating the Kiewa and other water schemes, and obtaining data and information for Parliament. As regards Morwell, the work relating to surveys, reports on sites, dimensions, and character of power houses, sub-stations, plant, &c., will have to be directed by the commissioners. For these purposes they will, of course, require an electrical engineer who must devote the whole of his time to the technical and business affairs of the commission and the various power schemes. The gentlemen selected have been chosen for their technical knowledge and business experience. Prof. Lyle is chairman of the Advisory Committee of Science and Industry and chairman of the standardisation committee of the Electrical Association. Mr. A. M'Kinstry is a member of the Institution of Electrical Engineers, and president of the Electrical Association in Victoria, and is general manager in Australia of the British Westinghouse Co. Mr. Swinburne's duties as member of the business board investigating the Defence department will not permit of him, for the next six months, dealing with details of the work of the commission. The attendance fees to be paid to each commissioner are not to exceed £500 a year.—*Melbourne Age.*

**A.C. versus D.C. Motors.**—During a five months' test period in the machine shop of the Lehigh plant of the Bethlehem Steel Co. 137 A.C. motors showed a perfect service record. During the same period there were 26 total failures among 353 D.C. variable-speed motors, and 39 total failures among 342 D.C. constant-speed motors. These 832 motors had an aggregate rating of 7,195 H.P., making the average motor size 7.2 H.P. The maximum rating was 25 H.P., and the minimum 0.5 H.P. The actual cost of repairs to a group of 300 motors in the same shop was investigated. These motors averaged about 4.3 H.P. each, which is about 40 per cent. less than the average of 7.2 H.P. for the entire shop. There were 27 total failures in this group during the five months, and the failures all occurred in the D.C. motors, of which there were 150. The 50 A.C. motors showed a perfect record. A large percentage of the failures originated in the commutators; where the breakdown did not actually occur at this point the commutator had to be at least repaired. In addition to such repairs or renewals about 40 per cent. of the armatures had to be rewound. In repairing the 27 armatures that failed about 432 hours were spent, involving a total cost of about $475, of which $260 was for labour and $215 for material. At this rate the annual expense would be $1,140. The forgoing maintenance cost is based on 27 failures in one group of motors in five months. However, in that same period there were 65 total motor failures in that shop and 432 machine-tool motor failures in the entire plant. The constant-speed motor failures could be reduced to a negligible quantity by using only A.C. motors for that service. Such a change should reduce the complete motor failures and the total motor maintenance expense by 40 per cent.—*Electrical World.*

**Electric Vehicle Trials.**—We learn that the Electric Vehicle Section of the Society of Motor Manufacturers and Traders is considering the question of organising a series of trials of electric motor vehicles.

**Faraday House Old Students' Association.**—The annual dinners of this Association will be resumed at the Holborn Restaurant on Friday, June 20th, with the president—Colonel Hubert C. Sparks, C.M.G., D.S.O., M.C., Croix de Guerre—in the chair. Tickets for the dinner are 10s. 6d. each, exclusive of wine. This is the first dinner since 1914, and in view of the presence in this country of a number of old students from abroad, who have been serving with the Forces, a large attendance is anticipated, and early application for tickets is desirable.

**Belgian Engineers Ostracise the Enemy.**—At their first meeting since the outbreak of the war, held on January 10th, the members of the Société Belge des Electriciens took the opportunity of refuting seriatim the lying assertions of the famous manifesto of the 93 German professors as to the authors and causes of the war. They emphasised their refutation by announcing their permanent severance of all scientific relations with Germans and their allies, and suppressing all exchanges of scientific papers and reviews.

**Wirelessly-Directed Aircraft.**—The statement made by Mr. Baker, the American Secretary for War, that a device had been invented in the U.S., whereby an aeroplane could, without a pilot, be made to travel 100 miles and alight near any assigned spot was followed, according to the *Engineer*, by a report from France that a ground-controlled aeroplane had actually flown over a prescribed course exceeding 110 miles in length, and had been landed when required in a certain aerodrome.

**Educational.**—MERTHYR.—Mr. S. Berry has presented £20,000 to the Merthyr Education Authority for the foundation of a technical school. An endowment fund is being raised, towards which Messrs. Guest, Keen & Nettlefold's, Ltd., have contributed £12,000, and the total subscriptions amount to £25,000.

**Organising Kinema Operators.**—A meeting of kinematograph operators was held on Sunday last, at which Mr. W. J. Webb, London District Secretary of the E.T.U. (who has recently lost his only son in Mesopotamia), stated that a strong Committee had been formed to draw up working proposals for the industry, and the London District Committee of the E.T.U. had instructed him to invite all the owners of kinema theatres in the district to a joint conference to discuss the proposals. Mr. J. F. Wyatt, president of the newly-formed London Central Operators' Branch of the E.T.U., advocated organisation to secure a living wage, and stated that branches had been started at several provincial centres. The proposals include the establishment of a uniform scale of wages and working conditions, a system of training, and an employment exchange for operators.

**Engineering Golfing Society.**—The Engineering Golfing Society held its first meeting since the spring of 1914, at Walton Heath, on the 20th inst.

Forty-eight members actually took part in the play, the Senior Division playing a medal round in the morning over the old course and a bogey round in the afternoon on the new course. The Junior Division tackled the courses in the reverse order. Fine weather prevailed, and a most enjoyable day was spent.

The President's Challenge Cup (Senior Division) was won by Mr. J. W. Towle, after a tie with Mr. Walter Phillips at 89 net, and the Wilson Challenge Cup (Junior Division) by Mr. A. P. Livesey, after a tie with Mr. W. W. Hughes at 93 net. The Scratch Prize was won by Mr. C. R. D. Pritchett with a score of 91.

In the Bogey Competitions the first prize in the Senior Division fell to Mr. F. Wood (2 down) and the second prize to Mr. J. H. Greathead (4 down). In the Junior Division, Mr. B. J. Hall took first prize and Mr. D. T. Powell the second, after a tie at 3 down.

**Electricity in Mining.**—Electricity is to be used in prospecting for gold in the Carngham District, Victoria, Australia. The basis of its application is the greater conductivity of a mineral reef as compared with ordinary country. Two electrical terminals are placed on the surface at some distance apart on a spot where a reef is likely to exist. If the current instead of flowing uninterruptedly from pole to pole is deflected, the intervening ground is tested more closely by means of a galvanometer and the position of the disturbing medium located. The country is then explored with a prospecting shaft.

**Empire's Resources Exhibition.**—It is proposed to hold an exhibition of manufactures and produce of the British Empire. The suggestion was unanimously supported at a representative gathering called by the British Empire League, at the British Empire Club, this week.

**Coal for Industrial and Domestic Use.**—In reply to a question in the House of Commons, Sir Auckland Geddes, Minister of Reconstruction, said he feared it would be necessary either to reduce the supply of coal to industry and for domestic use, or to limit even more strictly than at present the amount allowed to be exported. It was not possible to give a more definite answer until the effect of the reduced hours of working upon output was known. The output of coal per person employed continued to show a decrease without any shortening of the hours of working.

**London Traffic.**—As a result of a deputation of London M.P.'s to the Local Government Board, on Monday, Dr. Addison stated that the present condition of things was deplorable, and that he would recommend his colleagues to appoint a Select Committee to inquire into the matter of traffic congestion.

## OUR PERSONAL COLUMN.

*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*

**Central Station and Tramway Officials.**—Stafford Corporation Electricity Committee has recommended that the salary of the electrical engineer be increased from £387 10s. per annum to £550, inclusive of war allowances.

Morecambe T.C. has appointed Mr. JOSEPH BOYCE, electrical engineer and destructor manager of the borough of Todmorden, borough electrical engineer at £250 per annum. There were four applicants for the position.

Stoke Newington B.C. Electric Lighting Committee reports that Mr. HANN has returned from foreign service and resumed his duties as borough electrical engineer.

We are informed that Mr. L. C. BELLAMY was traffic manager, not manager, of the Rangoon Tramway & Supply Co., Ltd., as stated in our last issue.

**General.**—The marriage was celebrated on the 15th inst. at the Eccles Parish Church, between Major F. W. CLARK, M.C., late R.E., and Miss Freda Matthews, only daughter of Mr. and Mrs. Matthews, of Eccles. Prior to the outbreak of hostilities, Major Clark was connected with Messrs. Mather and Platt, Ltd. In August, 1914, he enlisted in the Manchester Pals, and was commissioned into the Royal Engineers in June, 1915, being appointed to a field company raised at Doncaster, of which town his father, Mr. W. Clark, J.P., was Mayor in 1912. Major Clark went to France in May, 1916, where he saw continuous active service until demobilised in February this year. He was appointed to the command of the 229th Field Company in September, 1917, was mentioned in dispatches, and received the Military Cross. Upon returning to civil life he joined Messrs. Ward & Goldstone, of Manchester. The bride is the daughter of Mr. F. J. O. Matthews, electrical engineer to the Vulcan Boiler & General Insurance Co., Ltd., of Manchester.

Prof. C. A. MIDDLETON SMITH, of the University of Hong-Kong, expects to reach England early in June.

Mr. W. H. SMEDLEY, audit accountant to the Aldershot Gas, Water & District Lighting Co., has been appointed costs accountant and assistant secretary to the Low Temperature Carbonisation Co., Ltd.

The *Times* states that Mr. GEORGE MORGAN, C.B.E., I.S.O., late Controller of the Post Office Stores Department, has received the King's permission to wear the Cross of Chevalier of the Order of Leopold.

Mr. E. E. SHARP, A.M.I.E.E., who has been demobilised, is shortly relinquishing his connection with Messrs. Chamberlain & Hookham, but will retain his interest in Venner Time Switches, Ltd. He is also engaging in a new business, of which particulars will be given later on.

Capt. H. NIMMO assumed duty on April 8th, 1919, as District Educational Officer for the A.D.M.S., Woolwich district, under the Army educational scheme.

Mr. THOS. D. KIRKLAND, of Broughty Ferry, who has been demobilised, has been appointed to succeed Mr. Andrew Henderson as manager of the Stirling and Bridge of Allan Tramways Co.

Mr. H. G. FRASER, chief electrical engineer of the Fife Coal Co., Leven, was entertained by the managerial head office staff of the company, and presented with a wallet of Treasury notes and a case of pipes, together with a case of spoons and sugar tongs for Mrs. Fraser, on the occasion of his leaving to take up the position of Glasgow agent for the firm of Messrs. Fraser & Chalmers.

Mr. H. F. PHILLIPS, of Messrs. H. Fentum Phillips & Co., electrical engineers, of 36, High Street, has been elected a vice-president of the Guildford Chamber of Trade.

The impending retirement of Prof. GISBERT KAPP, of the electrical engineering department of the University of Birmingham, is announced.

Capt. S. BOYS, D.S.O., who enlisted in the early days of the war, has relinquished his commission, being permanently unfit, the result of wounds received in action. He has now returned to the Edison Swan Electric Co., Ltd., to take up the position of district manager at its Sheffield depot.

Capt. J. N. STEPHENS, manager of wiring supplies sales for the British Thomson-Houston Co., has returned to Mazda House after having served for three years with the forces.

On May 2nd a gold watch was presented to Mr. E. W. HILLS by the staff of the Edison Swan Electric Co., Ltd., on his leaving, after 24 years' service, to join the Yorkshire Incandescent Electric Lamp Co., Ltd., as works manager.

Mr. R. AINSWORTH, M.I.E.E., for many years chief electrical engineer to Messrs. P. R. Jackson & Co., Ltd., Manchester, has taken over the managing directorship of the Manchester Armature Repair Co., Ltd., Ford Lane, Pendleton, Manchester. This business was established in 1906 by the late Lieut. G. H. Wilson, A.M.I.E.E., who unfortunately died recently whilst on active service in East Africa. A limited company has been formed, and Mr. Ainsworth has joined interests with the late Mr. Wilson's family.

Mr. CHARLES GORDON GRUNDY, engineer with the Electro-Metals Co., London, who has carried out many important contracts for electric furnaces in various parts of the country, was married on Monday last to Miss Monica Dromgoole, second daughter of Mr. Alfred Dromgoole, St. Helens, who is well known in that town for her exertions on behalf of local charities, and popular with all sections of the townspeople. Mr. Grundy is the eldest son of Mr. Jas. Grundy, St. Helens. After the honeymoon Mr. and Mrs. Grundy will take up their residence at Manchester.

Brig.-Gen. E. H. HILLS, C.M.G., D.S.O., F.R.S., and Major-General A. J. DE LOTBINIÈRE, C.B., C.S.I., C.I.E., have entered into partnership as consulting engineers, with the style of Hills & de Lotbiniere, specialising in the departments of hydro-electric generation and transmission, water supply, and drainage. Brig.-Gen. Hills will contribute specialist scientific knowledge to the partnership, while Major-Gen. de Lotbiniere has had 30 years' experience of civil engineering in India, particularly in connection with water-power schemes. He was successively chief engineer to Mysore, Cashmere, and Bengal before serving in the war, and carried out the Cauvery Falls scheme some 20 years ago. He was subsequently responsible for the Jhelum scheme in Cashmere. Pending the completion of office arrangements, Brig.-Gen. Hills is dealing with inquiries at 1, Campden Hill, W. 8.

Mr. WM. T. TALLENT-BATEMAN has resigned his position of chief switchgear engineer to the British Westinghouse Co., and is taking up the position of works manager to Messrs. Dorman & Smith, electrical engineers, of Salford. Upon leaving the Westinghouse Co., after a period of 16 years' service, he was presented, on behalf of the staff, by Mr. J. S. Peck, chief electrical engineer of the company, with a pair of very handsome silver three-branch candelabra.

**Roll of Honour.**—Private J. SHELMERDINE, M.M., 9th Manchester Regt., reported missing a year ago, is now officially presumed to have been killed. He was formerly employed at the Ashton-under-Lyme Corporation Electricity Works.

**Will.**—The late Prof. GEO. CAREY FOSTER, F.R.S., of University College, London, left £66,155 gross.

## NEW COMPANIES REGISTERED.

**John Birch & Co., Ltd.** (155,064).—Private company. Registered May 12th. Capital £240,000 in £1 shares (60,000 pref.). To take over the business of merchants and engineers carried on by a company of same name (incorporated 1893), and to carry on the business of merchants, engineers, contractors, iron and brass founders, steel converters, tool makers, metallurgical and manufacturing chemists, electricians, manufacturers of rolling stock, &c. The subscribers (each with one share) are: G. Redder and F. N. Kossiter, both solicitors, of 35, Coleman Street, E.C. Three of the first directors are to be nominated by the liquidator of the old company (as representing holders of ordinary shares numbered 1 to 45,000), and two are to be nominated by the holders of ordinary shares numbered 45,001 to 90,000. Directors' qualification, £500. No enemy subject may be a director, and three-fourths of the board, including the chairman, must at all times be British subjects, resident in the United Kingdom.

**Victor Plating Co., Ltd.** (155,050).—Private company. Registered May 10th. Capital £500 in £1 shares. Agreement with Frederick Walker, and to carry on the business of electroplate depositors, mechanical and electrical engineers, &c. The subscribers (each with one share) are: Frederick Walker, 156, Victoria Road, Aston, electro plate depositor; W. Lowe, 112, Wilton Street, Lozells, Birmingham, electro plate depositor; W. H. Young, 115, Church Street, Lozells, Birmingham, electro plate depositor. Table "A" mainly applies. Solicitor: T. W. Pickup, 23, Colmore Row, Birmingham.

**Albert Groves & Co., Ltd.** (155,121).—Private company. Registered May 14th. Capital £5,000 in £1 shares. To acquire the business of kinematograph outfitters and electricians carried on by A. Groves at Queen Victoria Street, Leeds. The subscribers (each with one share) are: A. Groves, 5, Graveley Court, Woodhouse Street, Leeds, kinematograph outfitter; C. Lishman, Ridge View Terrace, Leeds, kinematograph outfitter; F. Lishman, 19, Inglewood Terrace, Leeds, picture palace proprietor; A. Groves, C. Lishman and F. Lishman. Directors: Registered office: 4, Christopher Road, Woodhouse Street, Leeds.

**S. Hinchcliffe, Ltd.** (155,077).—Private company. Registered May 12th. Capital £5,000 in £1 shares. To acquire the business of electrical engineers carried on by S. Hinchcliffe at Balfour Street, Oldham. The subscribers (each with one share) are: S. Hinchcliffe, Balfour Street, Oldham, electrical engineer; A. E. Hibbert, 207, Frederick Street, Oldham, manager of cotton mill. First directors: S. Hinchcliffe and A. E. Hibbert. Registered office: 69, Mumps, Oldham.

**Bale & Hardy, Ltd.** (155,123).—Private company. Registered May 14th. Capital £20,000 in 8,000 7 per cent. preference shares of £1 each, 10,500 10 per cent. ordinary shares of £1 each and 30,000 deferred shares of 1s. Patentees and Government contractors, electricians, mechanical and general engineers, &c. The subscribers (each with one ord. share) are: J. W. Tully, 39, Victoria Street, Westminster, S.W.1, engineer; O. E. Yeo, Dacre House, Arundel Street, W.C., engineer. First directors to be appointed by the subscribers. Solicitors: Bruce, Millan & Co., Pomeroy House, 28a, Basinghall Street, E.C.2.

**Ballynahinch Electric Light & Power Co., Ltd.** (4,704).—Private company. Registered May 7th. Capital £5,000 in £10 shares. To carry on the business indicated by the title. The subscribers (each with one share) are: E. T. Wallace, Ballynahinch, Co Down, merchant; H. H. McAllister, Ballynahinch, Co. Down, merchant; H. H. Hinch, Co. Down, bank manager; F. E. Murray, Ballynahinch, Co. Down, merchant; J. Walker, Ballynahinch, Co. Down, chemist. The first directors are not named. Registered office: High Street, Ballynahinch.

**John Robertson (Belfast), Ltd.** (4,702).—Private company. Registered in Dublin May 7th. Capital £2,000 in £1 shares. Expert magneto repairers and adjusters. The subscribers (each with one share) are: J. Robertson, 42, Berry Street, Belfast, electrical engineer; Mrs. M. Robertson, 34, Delaware Street, Belfast. First director: J. Robertson. Registered office: 42, Berry Street, Belfast.

**Norrington & Landon, Ltd.** (155,177).—Private company. Registered May 15th. Capital £5,000 in £1 shares. Electrical, mechanical, and general engineers, &c. First directors: G. F. Norrington, 15, Fulshaw Avenue, Wilmslow, Cheshire, electrical engineer, and W. de M. Landon, Green Bank, W. Timperley, Cheshire, electrical engineer. Solicitor: R. A. Edgar, 20, Booth Street, Manchester.

## CITY NOTES.

**W. T. Glover & Co., Ltd.**

Mr. A. L. Ormrod presided at the annual meeting, held at Trafford Park, on May 12th. He referred briefly to the figures given in the report, and said that the report and balance sheet were sufficient evidence of the conservative manner in which the board had dealt with the accounts, and the satisfactory condition of the business. The adoption of the report was seconded by Mr. E. Claremont, and carried. The Chairman then moved a resolution as follows:—"That this meeting approves the action of Mr. A. L. Ormrod in entering into the agreement with Messrs. Vickers, Ltd., and pledges its support to the objects defined therein." This was seconded by Mr. L. B. Atkinson and carried unanimously. In his speech relating to the resolution, the chairman made a full explanation of the action of the board and himself. He had been associated with the company as a director since 1902, and had seen it gradually, but surely, emerge from a condition of chaos to one of prosperity and strength. He and Mr. Cooper took a strong hand in its reorganisation and finance, and with the co-operation of the other directors prevented the loss of the shareholders' money, which at one time appeared almost inevitable. He could not have had a better comrade than Mr. Claremont, the managing director, who was a master of organisation and detail, and possessed of all those qualities requisite to the management of an electrical engineering works. There might be bigger companies, and companies in the same line of business which had made bigger profits, and, indeed, this company might have made bigger profits, but no profit in Glovers had ever been made at the expense of its reputation or its goods. He could truly congratulate Vickers on the bargain that they had made, and on their prospects of controlling this firm. There was no goodwill in the price agreed, and, indeed, over the equivalent cash value of the shares offered in exchange for Glovers there was a considerable surplus of assets. Although the shareholding interest might change, the flag of Glovers in any event would remain flying. The entity continued and the management remained. As to the deal in detail, they were approached *vid* the Westinghouse Co. by the Metropolitan Carriage, Wagon & Finance Co., which had the controlling interest in the former on behalf of Vickers, Ltd., which was now the controlling factor of the lot. The Westinghouse Co. knew Glovers well. For many years the two firms had had business relations with one another. The Westinghouse Co. was in a position to appreciate the value of Glovers' work and management. Although the magnitude of its business and its transactions far exceeded Glovers', the career of the Westinghouse had been chequered, and it had undergone what, by the grace of God or the co-operation of their directors, they had avoided, viz., reconstruction. At an early stage he stated to the Westinghouse Co. that it must immediately realise it was not approaching a concern that had necessity or motive for selling, that a prelude to any serious conversation on such a matter must be a frank recognition of the value of the company's assets, and the only figure at which any negotiation could be opened must be a liberal one, and not one based on the dividends that had been paid. From the beginning their relations in such discussions had been cordial and frank. At a later stage of the negotiations the representative directors of the Metropolitan Carriage, Wagon & Finance Co. appeared on the scene, and they advanced a proposition materially below the one ultimately agreed with regard to the ordinary shares and with a suggestion that the preference shareholders might be given an equivalent rate to that which they were now receiving in some form of 5 per cent. preference shares of Vickers, Ltd., but when he looked up the value of Vickers 5 per cents. he discovered they were non-cumulative preference shares, and their then value in the Stock Exchange List was below that of Glovers. Personally, he saw no particular reason why Vickers should have desired to acquire the preference shares and not have been content with the control of the ordinary shares. He had, however, no hesitation in advising the preference shareholders to accept the cash offer of 17s. 6d. for a 5 per cent. preference share. The opportunities in these days were many and good of reinvesting the money on a much better basis, and even upon a better preference share, reckoned by the usual standards. The normal rate of a preference share of the highest industrial class to-day was possibly as low as 6 per cent., and ran to 7½ per cent., and at the price which Vickers were prepared to pay the preference shareholders, or such of them as might accept the offer subject to the other conditions, the shares would only yield to them £5 14s. Very many of the company's preference shareholders were also ordinary shareholders. In any event 87½ per cent. for a 5 per cent. preference security which had a substantial amount of debenture stock in front of it was a big price. After all, it was not a Government security, and at such a figure it was approaching that parity. Satisfactory as was the balance-sheet before them, the financial position of Glovers to-day was materially different to that at the date of the balance-sheet. There was at the moment a substantial overdraft of over £40,000. The debentures were becoming due, and their reissue or replacement would have to be speedily provided for. Then their large investment in the Trafford Power and Light Supply Co., Ltd., although sold to the Stretford District Council, was only sold subject to Parliamentary sanction, which had not yet been granted, and, indeed, might not be. As to the ordinary shareholders, the best dividends they had been receiving—he was not speaking of earnings—had been 7½ per cent., including the bonus, and Vickers for many years past had been distributing 12½ per cent., free of tax up to 5s. in the £. In other words, the best total dividend for a year which Glovers' ordinary shareholders had received had been 1s. 6d., less tax, when Vickers' had been receiving 2s. 6d., after the tax had been paid up to 5s. in the £. What Vickers' earnings recently had been, or what they could be taken to be, none of them knew, because the company's balance sheets had yet to be issued after a settlement had been come to with the Government authorities, but he had no doubt that the amount distributed by that company was in all probability far below what it could have paid had its board wished otherwise. If a shareholder took and held his Vickers shares, in exchange he would in all probability receive a dividend approximately 2½ times more than he had been getting in a concern similar to that which he had parted with, in that it had been paying well within the mark of its earnings. The acquisition of Glovers' shares by Vickers provided an increased chance for its management and workpeople. Vickers had behind it wealth, influence, and potentialities of orders. Glovers and all highly technical businesses in this country were faced at the present moment with a future with a very large measure of uncertainty. It was also faced with the necessity of going out for foreign business, of which it had had comparatively little in the past. It was faced with the necessity of increased expenditure both on its staff and on its development, and the possibilities of a large amount of further capital expenditure without the absolute certainty that its holding in the Trafford Power Co. was going to be realised. At best such money could not be available for capital expenditure or other purposes for some time to come. He knew that if this deal should not go through, Vickers were unlikely to bother about the acquisition of any other cable manufacturing company, but were going direct into the cable business, so that all other cable manufacturers and this company would be faced with a most formidable competitor, possessed of great engineering, electrical, and technical knowledge, of great influence, and vast resources. Such a contingency could not fail to have a very important bearing on the profits that might be earned in the future by Glovers and similar concerns. As ordinary shareholders in Glovers, it would pay them best to carry out this arrangement, and he had no doubt it would pay Vickers also. Mr. Ormrod read a letter that had been written to him by their managing director as follows:—

> A few months ago I pointed out to the board that on the withdrawal of Government work and the return to our normal business, which during the war had been entirely neglected, we were in the position of having to maintain a considerably increased output in order to cope with the greatly increased establishment charges, the only alternative being to reduce the establishment charges to their original figure which was obviously quite impracticable owing to the increase in values in all directions. I pointed out that all cable companies would to a large extent be in such a position, and that there would not be sufficient home trade orders to meet these increased outputs, and that the only chance of obtaining sufficient work was from the foreign markets, and that we (Glovers) had little or no foreign connection, and it would take some years to create it, and accordingly the only means by which Glovers could obtain sufficient work to cover their establishment charges would be by joining hands with a house having already foreign representation; and I said the ideal would be for such a house to have such a demand for cables for its own purposes as to absorb the whole of Glovers' output. This ideal I consider has been reached by the proposed amalgamation with Vickers, Ltd.—in fact, it would be difficult to suggest an amalgamation with anybody more suitable. I certainly know of none.

When the circular dated April 30th was sent out he had not reached the formality of an agreement with Vickers, but the agreement had since been signed. He recommended the fulfilment of the agreement, and his co-directors were at one with him. The completion of the sale was to take place on June 30th next.

**British Westinghouse Electric & Manufacturing Co., Ltd.**

The nineteenth annual meeting was held on Friday last at the Connaught Rooms, Great Queen Street, London, Mr. J. Annan Bryce in the chair. In proposing the adoption of the report, the chairman said that since the end of December there had been an issue of one million ordinary shares of £1 each, which had been subscribed and paid for in cash by the Metropolitan Carriage, Wagon and Finance Co. and its nominees, in accordance with its undertaking. The additional capital was required to provide for various needs in connection with the expansion of the business. Holders of preference shares had the option for two years of converting all or any of their holding into the new ordinary shares, and as stated in the recent circular the period of option ran from April 14th last till April 14th, 1921. The item for "sundry creditors and credit balances" showed a diminution of nearly £70,000 as compared with last year. In view of what they considered ample provision made under other heads, the directors had not thought it necessary this year to add to general reserve, especially as they proposed a large addition to the carry forward. Dividend at 8 per cent. took nearly £10,000 more than last year, and the carry forward was increased to £77,000, an increase of £26,000 over last year, but still £12,000

below the carry forward at December 31st, 1916. As the excess profits tax was to be reduced from 80 to 40 per cent. the burden under that head would be lessened in the current year, and it might be hoped that the reduction was the prelude to its abolition. It was disappointing that after the late Chancellor's announcement that he did not see how the tax could be continued after the war, the present Chancellor should excuse its continuance by the statement that he was waiting to see whether a scheme for a graduated tax on all trading profits could be devised. It was pointed out at the time of its original imposition that, as he (the chairman) said then, the tax was not only strangling enterprise, but was in many cases, their own among the number, radically unjust. It must be unjust in all cases such as theirs where a business had not attained full development before the war, because it did not affect other concerns doing similar business, which had at that time already attained development. The tax tended to strangle new enterprises because the rate of interest allowed was inadequate to attract capital. Numerous cases had come under his own personal observation where for that reason capital refused to risk investment in promising ventures, many of them designed to supply the place of commodities formerly imported from Germany, and which in default of production here Germany would, by hook or by crook, again manage to reintroduce into this country. Not only did the tax strangle new enterprise, but it swept away that portion of his profits which a prudent manufacturer applied to the development of his business. The German Government, recognising that danger, abstained till almost the end of the war from imposing a similar tax, with the result that the great German electrical concerns, the Allgemeine, Siemens, and Bergmann were enabled to accumulate vast fighting funds for post-war competition. Nor did any of the other belligerents such as France and Australia and lately India, which imposed an excess profits tax, carry it to the same extreme as our Government did.

The reduction of nearly £60,000 under the two headings "stock and completed work on contracts" in the balance sheet showed that the rate of out-turn and shipment had been speeded up. The gross profit was £52,000, and the net profit £58,000 larger than last year, enabling them to pay not only a larger dividend, but to increase the carry forward. About prospects, it was too early to speak with confidence. Trade was still hampered in various ways by political uncertainties, by Government restrictions, by difficulties in shipment, and in obtaining raw materials, and by labour unrest. The conclusion of peace should improve the position in many respects, notably in respect of political uncertainties and Government restrictions, though the latter would die hard, but the return to normal conditions must be slow. The question of the relations of labour to capital overshadowed all the others, but he believed that their Cassandras painted the picture too black. There were welcome signs that many of the most trusted Labour leaders realised the cardinal fact that the prosperity of the country depended on increased output, and that the idea on which the restriction of output and the use of improved machinery, namely, that there was only a fixed amount of work to go round, was based, was a fallacy. The truth, of course, was that the greater the output the greater was the amount of work to go round. The larger the output, the cheaper was the cost of the article. The cheaper the article, the larger its consumption. As Mr. Gompers told them that was thoroughly understood in America, where, when improved machinery was welcomed by the workmen, the output was twice as high, wages were twice as high, and the conditions of life greatly better. There had, indeed, been a high tariff, but that alone could not explain the facts. There were many signs that the importance of the human side of the relations of employer to employed was obtaining increasing recognition. It was more and more felt that they were all members of one body, and, indeed, the recognition of the truth of that Christian axiom was the main hope for the progress of civilisation, not only in national but international relations. He was happy to say in that connection that the relations of their management to the workmen continued to be, as they had always been, excellent. It had always been the endeavour of the management to foresee and anticipate the emergence of grievances, and the establishment a few years ago of a works committee had greatly helped in the prompt settlement of difficulties. With a view to still further improving the relations with the employés, the Metropolitan Co. had set aside the large number of 100,000 shares for subscription by them, and facilities would be given by way of advance on easy terms to enable the shares to be taken up. From the experience in past years of increased efficiency obtained by the grant of bonuses to members of the staff, he had great hope that advantage might be largely taken by them of that offer of shares. To return to the prospects of the business, he saw reason to think that in their particular industry, and in their particular case, there was no cause for despondency. As he said several years ago, the demand for electrical products was likely to be very large in an era of general reconstruction. Numerous Government reports, emphasised only this week by the introduction of fresh legislation, dilated upon the economy running annually into countless millions to be effected by the development of electrical power in this country and abroad; especially in the countries devastated by war, the field for its use was immense. But competition would be keen, not only from Germany, whose productive machinery, developed to the highest point before the war, had not suffered from it, but from other countries, especially America, which alone of the belligerents had actually made pecuniary gain, and that to a vast amount, out of the war. America was already competing keenly even in the most distant markets, and only by low cost due to greater output could England hope to hold her own. Individually their position was favourable. Their association with the Metropolitan Co. gave them great financial and selling strength, strength which had been within the last few weeks still further increased by the amalgamation of that company with the world-wide organisation of Messrs. Vickers. The new capital just raised would be applied to the extension of present and the creation of fresh manufacturing facilities, as well as to the development of their research and experimental department. As they knew for some time, they had had in operation a system of technical instruction which had obtained the commendation of the Minister of Education, and was serving as a model for similar systems in other factories. They hoped thus to secure such an increase of technical efficiency as would enable them to face, in combination with financial strength, competition no matter whence it came. As regarded the immediate future, he was glad to say that the amount of their orders at the end of last year exceeded by £500,000 those on the books at the end of 1917, while the orders received in the current year showed a gratifying increase. On the whole, he looked to the future of the company with confidence, but before he left general questions, he must tell them of a point which might have a bearing on the future. In connection with the transfer of control from America to England agreements were entered into with regard to division of territories. There had recently been negotiations for a revision of those agreements, with the object of giving them greater freedom of action. One of the conditions of the amended arrangement—at present provisional only—was that the British company should cease to use the name of Westinghouse, their friends wishing to confine the name to themselves. Under present circumstances they were ready to comply with their wish, because they were satisfied that the British company was strong enough to be independent of any adventitious help from a mere personal name. The number of men in work on December 31st, 1918, was 5,328, and of women 1,762, making a total of 7,090. Under arrangements made with the trade unions women were being replaced by returning men, and the number of women employed on the 10th inst. was 700, as compared with the pre-war figure of 520. As regarded labour cost, it would interest them to know that the percentage cost of male labour was in 1918 25 per cent., and of female labour 35 per cent. above the same costs respectively in 1917. The average weekly earnings of male and female labour, including that of boys, girls, and men on shifts in 1913 and 1918, were as follows: 1913, males, 29s. 5d., females, 12s. 7d.; 1918, males, 61s. 6d., females, 37s.; so that while male labour had risen a little over 200 per cent., female labour had risen 300 per cent. The change from war to peace conditions was proceeding by degrees, and the position was improving day by day, though it was still difficult to get skilled men to certain trades, which prevented their employing more men in classes of labour where the supply was good. Notwithstanding the general criticism as to the attitude of Labour, they as a firm had very little to complain of. They had been greatly aided in that respect by the beneficial action of the works committee. One happy result of the committee's working had been the diminution of accidents—there was only one fatal one during the year—and the number altogether was small. Having referred in detail to the educational activities of the company and to its record of service in connection with the war (mentioning that of 3,519 men who joined the Forces, 279 had made the great sacrifice), he concluded by referring with regret to the resignation of Mr. Lincoln Chandler, the managing director, in whose place Capt. Hilton had been appointed.

Sir Ernest V. Hiley, K.B.E., seconded the motion.

Replying to Mr. H. W. Birks, the Chairman said that now the excess profits tax was to be reduced the directors would doubtless be able to add a larger sum to reserve. With regard to the proposed change of name, it was not their seeking, but the agreement with the Metropolitan Co. gave them advantages which would more than counterbalance any disadvantages that might result from the company changing its name.

The report was adopted.

**Johnson & Phillips, Ltd.** The annual meeting was held on May 15th. Mr. W. Claude Johnson presiding. He said that the accounts showed a further considerable improvement. The trading profit for the year, after charging £13,965 for maintenance of buildings, plant, &c., amounted to £80,276, an increase of £10,000. The directors had thought it advisable to write a further £2,500 off patents, which reduced that item to £2,500, and also to transfer a further £10,000 to reserve. Rather more than half of the first mortgage debenture stock had been redeemed and paid for out of profits, and the assets of the company now exceeded the liabilities by £332,987, which showed very clearly that the business was in a thoroughly sound position. The amount of work in hand was very large, and new orders continued to come in in a very satisfactory manner. They included a large

percentage of foreign and colonial demands, which was always a good sign. The value of research work was universally admitted. They more than ever realised the necessity for developing and continuing this work. They had established a laboratory devoted entirely to research work in electrical and physical science. Already they had an extensive programme, which was likely to extend over some years. The first fruits of this new development they hoped to exploit very shortly. They were confident it would yield beneficial results to the company. Proceeding to refer to the proposed increase of capital by the issue of 175,000 new ordinary shares, he said it was the intention of the directors to issue the new capital almost at once, and they had made arrangements with a well-known issuing house to purchase the whole of the 175,000 shares from them at a premium. They had stipulated that existing shareholders who were on the register should receive preferential treatment in allotment. He might say that for some years past the board had had in contemplation an issue of new capital in one form or another to cope with the continual expansion of the business. In consequence of the outbreak of war, however, the project had to be postponed. As a result the directors had felt obliged to place considerable sums annually to reserve, out of income, in order to provide the extra capital needed to carry on the business. Since the formation of the company in 1905, fourteen years ago, £95,500 had been set aside out of the profits of the business for depreciation, while during the same period over £95,000 had been expended (and charged against profit and loss account) for the repairs and maintenance of the property. Further, and he was sure they would appreciate the importance of the fact, during those fourteen years over £166,000 had been spent on new plant, machinery, and buildings. On the other hand, the only increase in the working capital of the business, other than that provided by the reserves he had mentioned, had been the issue in 1910 of £50,000 second debentures. Against this, however, a sum of over £80,000 had been spent in the redemption of the first mortgage stock of the company. But the reasons for providing more capital were very apparent also from other items in the balance sheet. Let them look at the item of creditors. The volume of trade they did was so great that they had been forced to work on credit, instead of taking full advantage of the usual trade discounts allowed on their purchases. If he added that during the current year they hoped to largely increase the turnover, it would be apparent to all that by taking advantage of those trade discounts alone a handsome dividend was provided on the new capital. Then they would be able to buy in the cheapest market for cash. Another point of equal interest was the fact that from want of adequate capital they had hitherto to husband their resources most carefully so as to provide the necessary funds out of profits, instead of distributing the same on a more liberal scale. As they saw, they had accumulated big reserves. He might say they were genuine reserves. They were going to put up additional buildings at once and equip them with the most up-to-date machinery to enable them to participate to the fullest extent in the anticipated increase of business. Of course, there were many important manufactures with which they would have to deal.

Subsequently a resolution was unanimously agreed to authorising the increase of capital as referred to by the chairman.

**Brush Electrical Engineering Co., Ltd.**

At the annual meeting on Monday, Mr. E. Garcke, chairman, said that the gross profit on trading for the past year was £157,000, compared with £89,000 in the preceding year, an increase of £68,000. They proposed a dividend of 18 per cent. on the ordinary stock, being 6 per cent. per annum for the three years of the war period, for which no dividend had been paid. They would thus have paid dividends averaging 6 per cent. per annum for the five war years. The capital and the assets were written down very heavily some years ago, so that the company was now in a very strong financial position. They were engaged during the past year in turning out war material at full pressure. With the signing of the Armistice agreements were arrived at with the various Government Departments in respect of the war contracts which they had on hand, either for cancellation outright or for deliveries to be reduced to the minimum basis that would assist them in carrying on while changing over to their normal manufacturing lines. They had been successful in booking valuable orders, which included tramcars and trucks, motor omnibus bodies, and other rolling stock. They anticipated a good demand in that department for new stock and renewal parts. On the engineering side the demand for their standard productions had been active during the war, and they found themselves immediately called upon for an increased output of the Brush-Ljungström sets, transformers, and other auxiliaries. Further extensions of buildings and plant to cope with the situation were well in hand at Loughborough. The outlook as regarded that section of their business was encouraging. Without increased production the export trade of the country must suffer so long as the cost of material and labour remained on its present scale. Their relations with their workpeople had been harmonious throughout the year. Their prosperity was conditioned by the labour situation and by impending electrical legislation. The best kind of electrical legislation at the present moment would be the repeal of previous Acts, and the appointment of judicial and competent commissioners who would listen impartially to the representatives of divergent views, and then decide what was the best thing to be done in each particular case, due regard being had to general experience. The administrative machinery required must be such as would enable the industry to do its work without political interference.

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**Submarine Cables Trust, Ltd.**—For the year to April 15th revenue amounted to £27,319 and expenses to £1,934, leaving £25,385; £93 was brought forward, making £25,478. After providing £14,268 to meet payment of coupons, £11,144 has been transferred to the redemption fund and £66 carried forward.

**Brisbane Electric Tramways Investment Co., Ltd.**—Dividend 4s. per share, free of tax, on the ordinary shares, making 8 per cent. for the year; £20,000 to the reserve, and £28,202 carried forward.

**Lima Light, Power & Tramways Co.**—Net profit £P147,196, plus £P94,360 brought forward. After paying dividends and providing for general amortisation fund reserve, stores, repairs, &c., £P95,063 is to be carried forward.

**Electric Construction Co., Ltd.**—Final dividend at the rate of 9 per cent. per annum on the ordinary shares, making 7½ per cent. for the year, plus a bonus of 2½ per cent. on the ordinary, less tax.

**Altrincham Electric Supply, Ltd.**—Dividend of 9s. per share (against 3s. 6d.) on the deferred shares. It is proposed to increase the capital to £100,000 by the creation of 50,000 new shares of £1 each.

**Siemens Bros. & Co., Ltd.**—Final dividend of 5s. per share, free of tax, making 10 per cent. per annum, free of tax, for the year ended December 31st last.

**Edison Swan Electric Co., Ltd.**—Interim dividend of 3 per cent. (less tax) in respect of old ordinary shares.

**Babcock & Wilcox, Ltd.**—Final dividend of 9 per cent., making 15 per cent. for the year.

**Vera Cruz Electric Light, Power & Traction, Ltd.**—Interim dividend of 5 per cent., less tax.

**Alley & Maclellan, Ltd.**—After providing for excess profits duty, writing off £12,071 for depreciation of property, plant, machinery, &c., and transferring £20,000 to reserve, a dividend of 6 per cent. for 1918 is to be paid, carrying forward £8,763.

## STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange business is still remarkably active. Money continues to flow into the markets. Speculation flourishes. Investment is on a broad scale. Strength in Consols and the War Loans finds reflection in all other gilt-edged securities. An exception is furnished by London electricity supply shares. This department is weaker in consequence of the second reading of the Government Bill.

Various West End electricity shares have suffered. Westminsters, Chelseas, Kensingtons, and Londons are amongst them. The falls range from 2s. 6d. to 7s. 6d. There is no great pressure to sell, but the market looks for possible realisations on the part of holders, and a few selling orders started the list crumbling, because there is no particular backing for the moment, owing to the uncertainty. The clauses in the Bill that give rise to uneasiness in the minds of the investor were quoted here last week, and although nothing definite is expected to materialise for a long time to come, and although strong opposition will be raised to some of the proposals, the outlook is obscure, and this checks buying even if it does not induce much selling.

Meanwhile, the manufacturing shares continue to show marked strength. What may be poison for supply companies is regarded as stimulant for the manufacturing concerns. Edison Swans have risen to 25s. 9d., and the new shares to 4s. premium. General Electrics maintain their big advance. Electric Constructions keep good at 25s. 6d. The dividend and bonus, making 10 per cent. for the year, are the same as for 1917. English Electrics have hardened to 27s. 9d. British Insulated jumped to 2½, although in this case the reason is attributed to the large interest the company is stated to hold (or to have held) in Automatic Telephone shares, which have recently enjoyed so substantial an advance, and which are now quoted 37s. 6d. The cable manufacturing issues are also firm. Telegraph Constructions have gone up to 25½, Callenders to 10½, and other shares in this group, although unchanged nominally, are as hard in tone as they are to buy. Concurrently, Siemens have touched 7, the new being 6¾, and various of the explosive descriptions improved, Vickers amongst them. Babcock & Wilcox receded to 3¾, a reaction of 5s., upon disappointment that the dividend is maintained at 15 per cent (tax free), without any mention of the long-expected bonus. But some say that this is merely a postponement. India-Rubbers are 12s. 6d. up. British Aluminium lost their last week's improvement.

Marconis have jumped to 6 7/16, fresh buying being set in action by the news that the company's claim for compensation will be heard early next month. The preference kept pace at 5¼. Spanish and General have been resurrected, with business round about 16s. Americans fell back to 31s. after

being 33s.; guesses at truth hint at an unsympathetic attitude on the part of the U.S. Government towards privately-owned wireless enterprises. Canadian Marconis have gone back from 19s. to 17s. There was a fairly heavy bull account in both Americans and Canadians, and probably the rise brought in the profit-taker.

One of those quick changes for which the market is famous (or notorious) has just taken place in Mexican issues, Government, railway, and utility. According to rumour, the Mexican President has been informed plainly by Great Britain, France, and America that unless immediate steps are taken for quelling internal disturbances in Mexico, the result may be unpleasant for the President. Official confirmation has not been received so far, but it is significant that some of the Mexican securities have risen as much as 10 points during the past week.

The Utility bonds and shares are better, though not to any dramatic degree so far. Rio Tramways bonds further hardened with another rise in the exchange. Reports have come in this week showing what extraordinary effects were produced by the influenza epidemic in Rio; business paralysed, transport almost entirely stopped, and everything held up while the 'flue was at its height. Brazilian Tractions have gained 5 points.

Victoria Falls Power ordinary have gained a trifle at 22s., and the preference at 26s. 3d., on the liveliness in Kaffirs which has been dignified by the name of a boom. That something will be done very shortly to help the gold-producing industry is at the root of the animation. Of the foreign division, British Columbia Electrics made a good showing, and substantial recoveries are to be noted. Anglo-Argentine Trams are rather better. Home Railways continue to give way, Metropolitans and Districts being 1 and ½ lower respectively.

## SHARE LIST OF ELECTRICAL COMPANIES.

| | Dividend 1917. | Dividend 1918. | Price May 20, 1919. | Rise or fall. | Yield p.c. |
|---|---|---|---|---|---|
| **Home Electricity Companies** | | | | | |
| Brompton Ordinary | 10 | 8 | 62 | — | £5 8 16 |
| Charing Cross Ordinary | 4 | 4 | 8½ | −½ | 6 3 1 |
| do. do. do. 4½ Pref. | 4½ | 4½ | 9½ | — | 6 18 4 |
| Chelsea | 5 | 5 | 26 | −1/2 | 4 3 9 |
| City of London | 8 | 8 | 11½ | +½ | 6 14 6 |
| do. do. 6 per cent. Pref. | 6 | 6 | 10 | — | 6 0 0 |
| County of London | 7 | 7 | 10a | — | 6 18 2 |
| do. do. 6 per cent. Pref. | 6 | 6 | 9½ | +½ | 6 1 1 |
| Kensington Ordinary | 7 | 6 | 5½ | −½ | 8 4 4 |
| London Electric | Nil | Nil | 1½ | −½ | Nil |
| do. do. 6 per cent. Pref. | 5 | 6 | 8½ | — | 7 14 10 |
| Metropolitan | 4 | 5 | 8½ | — | 6 0 0 |
| do. 4½ per cent. Pref. | 4½ | 4½ | 8½ | — | 6 18 6 |
| St. James' and Pall Mall | 9 | 10 | 7½ | — | 7 0 4 |
| South London | 5 | 5 | 27 | — | 7 5 6 |
| South Metropolitan Pref. | 7 | 7 | 20/8 | — | 6 16 7 |
| Westminster Ordinary | 9 | 8 | 6½ | −½ | 6 10 8 |
| **Telegraphs and Telephones.** | | | | | |
| Anglo-Am. T l. Pref. | 6 | 6 | 99 | +½ | 6 1 0 |
| do. Def. | 1½ | 33/6 | 22½ | — | 7 8 0 |
| Chile Telephone | 8 | 8 | 7½ | — | 5 8 6 |
| Cuba Sub. Ord. | 7 | 7 | 11½xd | +½ | *8 4 5 |
| Eastern Extension | 8 | 8 | 16½xd | — | *4 17 9 |
| Eastern Tel. Ord. | 8 | 8 | 164½xd | — | *4 17 8 |
| Globe Tel. and T. Ord. | 7 | 8 | 16½ | — | *4 19 3 |
| do. do. Pref. | 6 | 6 | 10½ | — | 5 14 3 |
| Great Northern Tel. | 22 | 22 | 89 | +1½ | 6 17 6 |
| Indo-European | 13 | 13 | 85xd | — | 5 18 2 |
| Marconi | 20 | 20 | 6⅞ | +⅛ | 3 2 6 |
| Oriental Telephone Ord. | 10 | 15 | 2⅛ | · ⅛ | 6 4 9 |
| United R. Plate Tel. | 8 | 8 | 7½ | — | *5 1 7 |
| West India and Panama | 1/3 | 1/3 | 1⅛ | — | *4 8 4 |
| Western Telegraph | 8 | 8 | 17½ | +½ | *4 12 9 |
| **Home Rails.** | | | | | |
| Central London Ord. Assented | 4 | 4 | 63½ | — | 6 6 0 |
| Metropolitan | 1 | 1½ | 27 | −1 | 4 12 7 |
| do. District | Nil | Nil | 24½ | −½ | Nil |
| Underground Electric Ordinary | Nil | Nil | 8a | — | Nil |
| do. do. "A" | Nil | Nil | 9⅜ | +3d. | Nil |
| do. do. Income | 4 | 5 | 96 | −½ | *5 5 3 |
| **Foreign Trams, &c.** | | | | | |
| Adelaide Sup. 6 per cent. Pref. | 6 | 6 | 108 | — | 6 11 4 |
| Anglo-Arg. Trams. First Pref. | 5½ | Nil | 8½ | +½ | — |
| do. do. 2nd Pref. | — | — | 3 | — | — |
| do. do. 5 Deb. | 5 | 5 | 68½ | — | 7 8 5 |
| Brazil Tractions | — | — | 64 | +5 | — |
| Bombay Electric Pref. | 6 | 6 | 102 | — | 5 11 7 |
| British Columbia Elec. Ry. Pfce. | 5 | 5 | 60½ | +½ | 8 5 4 |
| do. do. Preferred | Nil | Nil | 44½ | +4 | Nil |
| do. do. Deferred | Nil | Nil | 41½ | +9 | Nil |
| do. do. Deb. | 4½ | 4½ | 62 | — | 6 17 4 |
| Mexico Trams 5 per cent. Bonds | Nil | Nil | 60½ | +½ | Nil |
| do. 6 per cent. Bonds | Nil | Nil | 48½ | +2½ | Nil |
| Mexican Light Common | Nil | Nil | 37 | — | Nil |
| do. Pref. | Nil | Nil | 51 | — | Nil |
| do. 1st Bonds | Nil | Nil | 67 | — | — |
| **Manufacturing Companies.** | | | | | |
| Babcock & Wilcox | 15 | 15 | 86 | −½ | 8 17 6 |
| British Aluminium Ord. | 10 | 10 | 1½ | −⅛ | 5 18 6 |
| British Insulated Ord. | 25 | 12½ | 2½ | +⅛ | 5 11 1 |
| British Westinghouse Pref. | 7½ | 8 | 2½ | +⅛ | 5 19 6 |
| Callenders | 25 | 25 | 10½ | +½ | 6 3 0 |
| do. 6½ Pref. | 5 | 6½ | 5½ | — | 6 8 10 |
| Castner-Kellner | 25 | 20 | 8½ | — | 6 3 1 |
| Edison-Swan, "A" | — | — | 1⅞ | +⅛ | 5 17 0 |
| do. do. 5 per cent. Deb. | 4 | 5 | 75½ | — | 6 12 3 |
| Electric Construction | 10 | 10 | 1⅜ | — | 7 16 0 |
| Gen. Elec. Pref. | 6 | 6½ | 10½ | +½ | 6 8 10 |
| do. Ord. | 10 | 10 | 22 | — | *4 11 0 |
| Henley | 25 | 25 | 29xd | — | 5 5 3 |
| do. 4½ Pref. | 4½ | 4½ | 8½ | — | 6 16 2 |
| India-Rubber | 10 | 10 | 17½ | +½ | *5 16 0 |
| Siemens Ord. | — | 10 | 64½ | — | *7 4 0 |
| Telegraph Con | 20 | 20 | 25½ | +½ | 4 18 6 |

*Dividends paid free of Income Tax.

## MARKET QUOTATIONS.

**It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.**

### Wednesday, May 21st.

| CHEMICALS, &c. | | Latest Price. | Fortnight's Inc. or Dec. |
|---|---|---|---|
| a Acid, Oxalic | per lb. | 1/5 | .. |
| a Ammoniac Sal | per ton | £80 | .. |
| a Ammonia, Muriate (large crystal) | " | £78 | .. |
| a Bisulphide of Carbon | " | .. | .. |
| a Borax | " | £30 | £6 dec. |
| a Copper Sulphate | " | £42 | .. |
| a Potash, Chlorate | per lb. | 1/6 | 3d. dec. |
| a " Perchlorate | " | 1/3 | 6d. dec. |
| a Shellac | per cwt. | £16 | £4 inc. |
| a Sulphate of Magnesia | per ton | £15 | .. |
| a Sulphur, Sublimed Flowers | " | £28 | £3 dec. |
| a " Lump | " | £20 | £3 dec. |
| a Soda, Chlorate | per lb. | 10d. | .. |
| a " Crystals | per ton | £70 | .. |
| a Sodium Bichromate, casks | per lb. | .. | .. |
| **METALS, &c.** | | | |
| c Brass (rolled metal 9" to 13" basis) | per lb. | 11¼d. | .. |
| c " Tubes (solid drawn) | " | 1/2½ to 1/2½ | ½d. dec. |
| c " Wire, basis | " | 1/- | .. |
| c Copper Tubes (solid drawn) | " | 1/3½ | ½d. dec. |
| c " Bars (best selected) | per ton | £114 | .. |
| c " Sheet | " | £114 | .. |
| c " Rod | " | £114 | .. |
| d " (Electrolytic) Bars | " | £88 | £2 inc. |
| d " " Sheets | " | £101 | .. |
| d " " Wire Rods | " | £91 | £2 inc. |
| d " " H.C. Wire | per lb. | 11⅝d. | ½d. inc. |
| f Ebonite Rod | " | 8/- | .. |
| f " Sheet | " | 2/6 | .. |
| n German Silver Wire | " | 2/6 | .. |
| h Gutta-percha, fine | " | 11/- | .. |
| h India-rubber, Para fine | " | 2/5½ | 1d. in. |
| i Iron Pig (Cleveland warrants) | per ton | Nom. | .. |
| i " Wire, galv. No. 8, P.O. qual. | " | £40 | .. |
| g Lead, English Pig | " | .. | .. |
| g Mercury | per bot. | Nom. | .. |
| e Mica (in original cases) small | per lb. | 9d. to 4/6 | .. |
| e " " " medium | " | 5/- to 10/- | .. |
| e " " " large | " | 12/6 to 25/- & up. | .. |
| d Silicium Bronze Wire | per lb. | 1/4 | ½d. inc. |
| r Steel, Magnet, in bars | per ton | .. | .. |
| g Tin, Block (English) | " | £235 to £236 | £12 inc. |
| n " Wire, Nos. 1 to 18 | per lb. | 4/- | .. |

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

**Stock Exchange Notice.**—The following are to be officially quoted:—

Crompton & Co., Ltd.—76,769 ordinary shares of £1 each, fully-paid (Nos. 1 to 76,769); 133,760 preference shares of £1 each, fully-paid (Nos. 1 to 28,342 and 30,583 to 136,000); and £130,000 6 per cent. first mortgage registered debentures (Nos. 1 to 1,250 and 1,451 to 1,550) (£100 and £50).

**Bath Electric Tramways.**—The report for the year 1918 states that after charging £10,614 for repairs and renewals, including £3,954 brought forward, after deducting £1,876 for special expenditure, there is an available balance of £24,892, out of which the following amounts have been deducted: £5,628 for interest on 4½ per cent. first mortgage debentures, £1,000 for sinking fund, £502 interest on loan, £432 expenses on issue of debentures in past years, £3,750 for dividend on preference shares, leaving £13,580. From this £7,500 has been transferred to renewals and £6,080 to replacements and contingencies.

**Launceston & District Electric Supply Co., Ltd.**—During 1918 the revenue receipts were £1,279, as against £1,073 in 1917, and the working expenses £672. Consumers increased from 246 to 265, and lamps connected from 7,698 to 8,661. Motors connected now number 19, with a total of 58 H.P. Gross profit £606, after deducting bank charges and preference dividend, paying 3 per cent. on the ordinary shares, putting £150 to depreciation, writing £50 off preliminary expenses, and putting £75 to reserve. £53 is carried forward.

**West India & Panama Telegraph Co., Ltd.**—The amount to credit of revenue for 1918 is £120,162, and the expenses have been £91,463, leaving £28,688, plus £3,324 from interest on investments and £5,268 brought forward. £5,000 has been placed to general reserve, and the directors propose to pay final dividends for the year on first and second preference shares at 6s. per share, and on the ordinary shares 6d. per share and a bonus of 8d. per share, both free of tax, carrying forward £3,222. Although traffic receipts show an increase, this has been more than counter-balanced by the increased cost of labour and materials.

**British Electric Transformer Co., Ltd.**—Dividend of 7 per cent., and 2½ per cent. bonus, on the ordinary shares, making 12½ per cent. for the year; £2,000 to depreciation reserve; £7,500 to reserve; £1,178 for directors' extra remuneration, and £3,964 carried forward.

# THE ELECTRIC AUTOMOBILE FOR COMMERCIAL USE.

By FRANK AYTON, M.I.E.E. (Hon. Secretary of the Electric Vehicle Committee of Great Britain.)

(Abstract of paper read before the Association of British Motor and Allied Manufacturers, Ltd.)

My main object in presenting this paper is to establish the view that British automobile manufacturers may with advantage take up the building of electric vehicles, especially those for commercial purposes, as an adjunct to the construction of the petrol types.

As one who, for some years, has studied the question very closely, and who has for a long time been an ardent petrol motorist, I see no possibility of the electric ousting the petrol vehicle in any sphere but that of short-distance, frequent-stop work. Experience indicates that to each particular type, petrol, steam, and electric, belongs a fairly well defined sphere of utility. The manufacturer who can offer to his customers vehicles suited to every class of work will undoubtedly place himself in a position of advantage.

The electric is essentially a moderate speed vehicle, and its radius of action is limited by the mileage which can be obtained from the fully charged battery. This characteristic limits its sphere of useful application, generally speaking, to urban and suburban districts. When stops are frequent, and where busy thoroughfares have to be negotiated, there are other advantageous features, *i.e.*, ease of manipulation, due to the absence of any "change speed" gear, high rate of acceleration, automatic cessation of power consumption when standing, and the self-starting characteristic of its power unit. Still other points of merit include the absence of fire risk, enabling it to be taken into premises without affecting the fire insurance thereon, and simplicity of operation. The most valuable and important features are economy in operating cost and reliability, due to low cost for repairs, longer life usually obtained from tires, economy in power, the initial efficiency does not suffer declension with wear or period of use to anything like the extent it does with petrol or steam vehicles, and to the fact that weather and atmospheric conditions have no bearing upon its efficiency and capability for doing the day's work.

A 3-ton lorry fitted with the usual size of battery will cover from 35 to 40 miles on one charge, given fairly level and good surface roads. In the case of light electric passenger cars, a considerably greater mileage per battery charge is now obtainable. Over give-and-take roads of average quality, 70 or 80 miles per charge is quite common, while authentic records exist of distances of the order of 100 miles, more or less, having been covered.

The petrol vehicle finds its sphere largely in performances which are impossible for the horse; the electric enters into competition with the horse, and will rapidly displace him. I foresee the time when, with the establishment of charging stations at frequent intervals along all our main roads, electric road transport services between towns will be inaugurated for goods in connection with which the time taken for transit is not of first importance. The advent of that development will be materially hastened by the adoption of a system of interchangeable batteries. The Electric Vehicle Committee had the standardisation of battery boxes and means of supporting them under consideration, but came to the conclusion that the time was hardly ripe for action.

It has often been asserted that the electric vehicle is too slow. Quite apart from the limit to its radius of action, this characteristic in itself militates against competition with the petrol vehicle for long-distance work. But in the sphere for which it is proved to be suitable, high maximum speed gives little, if any, advantage. In traffic the rapid acceleration of the electric gives it an appreciable advantage over the petrol type.

The results obtained in Birmingham in the application of electric vans for bread delivery go to prove the fallacy of the contention that the electric is wanting in speed. The first electric 30-cwt. van acquired by the firm was put on to a round that had up to then been covered by a modern type of petrol van of the same size. The work comprises a round of 11¼ miles, with some 50 delivery stops, which is covered three times per ordinary week-day and four times on Saturday. Compared with the average time taken by the petrol vehicle to do the trip, a saving of 30 minutes per trip was made by the electric. The weekly cost of electrical energy for this vehicle averaged 13s. 4d., while the cost of petrol for the vehicle previously in use averaged £2 10s. In 1917 Mr. J. A. Priestley, of Sheffield, made some careful tests over a measured mile in order to ascertain the travelling time, with a definite number of stops, of a 20-h.p., 2-ton petrol car of one of the best makes, a 2-ton Edison electric vehicle, and a horse-drawn vehicle consisting of a single horse drawing a four-wheeled covered wagon. Two tests were made, "A" being with a stop every 10 yd., and "B" with a stop every 20 yd. The times taken for covering the distance of one mile were as below:—

| | Test "A." | Test "B." |
|---|---|---|
| Horse and cart ... ... | 33.52 mins. | 32.40 mins. |
| Petrol wagon ... ... | 14.80 mins. | 10.85 mins. |
| Electric wagon ... ... | 11.33 mins. | 9.33 mins. |

The greatest development has taken place in the United States, and comparatively few people on this side of the Atlantic appreciate the extent to which electric vehicles are employed in that country. It is computed that the number of electric vehicles of all types in use there is over 70,000. In 1917 the new vehicles sold during the previous year totalled some 8,000, of which approximately 2,500 were of the commercial type. The remainder consisted of about 4,000 cars of the private passenger carrying type, and about 1,500 industrial trucks.

It is hardly likely that the large fleets of electric vehicles have been acquired for any other reason than that their use gives the desired service at the lowest possible cost, and with complete dependability.

In this country the adoption of the electric for commercial purposes has, considering the difficulties due to the war, made fair progress. Actual testimony from users is, perhaps, the best evidence that can be adduced in support of the claims made on behalf of the electric.

I am convinced that it will not be long ere our large cities, particularly London, will be served by electric taxicabs. It is noteworthy that in the very home of the petrol car in the United States, viz., Detroit, electrics on the streets are showing a marked economy over petrol cabs, the operating expenses of the former, including drivers' wages, establishment charges, interest, depreciation, electricity, repairs, garage and tire expenses, averaging only 60 to 66 per cent. of the cost of operating the petrol cabs. The public in Detroit show a distinct preference for the electric cabs, and will often wait a considerable time for the return of an electric cab rather than take a petrol cab standing on the rank. Schemes are afoot to establish electric taxicab fleets in New York and other large cities in the States. With electric taxis built, as they are to-day, to run at maximum speeds of 25 m.p.h., and with a range of action of from 60 to 75 miles on one charge, it must be obvious that there is an opening for their extensive employment. They can be arranged for battery substitution, and in this way may be kept in service for long hours at a stretch.

Within the last few years certain British engineering firms have taken up the manufacture of these machines, and it is satisfactory to be able to say that at the present time commercial electric vehicles are being built in this country which compare most favourably with the best makes from America. The greatest electrical improvement that has taken place is in the battery.

It may be said that between the Ironclad-Exide and the Edison accumulators, from the point of view of reliability and cost of maintenance, there is very little to choose. It must not, however, be assumed that what is known as the ordinary flat plate type of lead-acid accumulator is unsatisfactory, though there have been many failures in connection with it in the past. The flat plate type is not able to withstand the effects of vibration so well as the Ironclad-Exide or the Edison types, and consequently its life is appreciably shorter. I have confidence, however, that British accumulator manufacturers will, in a very short while, be able greatly to improve the flat plate cell, giving it a considerably longer life than it at present possesses.

The usual design of commercial electric vehicle embodies the use of a single centrally-located series wound electric motor driving the rear wheels by a double chain transmission. The usual drive is from the motor spindle to the counter-shaft, by a tooth type silent chain. The driven sprocket on the counter-shaft is combined with the differential. From sprocket wheels fitted to the ends of the counter-shaft, roller type chains transmit the power to the road wheels. This simple arrangement has proved very satisfactory, and is employed in by far the greater number of vehicles constructed in America. Another method is to drive the counter-shaft through bevel gear, the bevel pinion being connected to the motor by means of a connecting-shaft, which, due to its torsional flexibility, gives a cushioning effect in starting, and acts as a flexible shaft. In the case of light delivery vans the live axle drive, with either bevel or worm gear, is very frequently employed, the motor in most instances being mounted directly on the forward end of the propeller shaft casing, this arrangement making it possible to connect the armature to the propeller shaft without the intervention of a universal joint. Some departures from the standard practice embody a front wheel drive, which is giving satisfactory results in service. In this case there are two motors, one to each wheel, the power being transmitted to the latter by a single reduction gear, which consists of a helical tooth pinion meshing with a gear wheel having internal teeth, which is attached to the inside face of the road wheel. In the case of the rear wheel drive a single reduction spur gear between each motor and the driving chain sprocket is employed, an ordinary roller chain transmitting the power from this sprocket to the road wheel.

The two-motor arrangement eliminates the necessity for a differential; it also economises current when use is made of the series parallel system of control. There are a few special designs in which the driving motor is enclosed within the road wheel; the balance gear drive, in which the motor casing

is incorporated in the back axle; and the concentric gear drive.

In the design of commercial electric vehicles, it is important to eliminate friction to the greatest possible extent, and to provide for moderate speeds only. As to the most suitable speeds, those given below may be taken as a fairly good guide :—

| Carrying capacity. | Speed, m.p.h. |
|---|---|
| 1,000 lb. | 12 to 13 |
| 2,000 lb. | 10 to 11 |
| 3,000 lb. | 10 |
| 2 tons | 8 to 9 |
| 3 tons | 7 to 8 |
| 4 tons | 6½ to 7½ |
| 5 tons | 6 to 7 |
| 6 tons | 6½ |

The series wound traction motor is of the most robust type, as is evidenced by the low cost of upkeep. It is a very rare thing for an electric vehicle motor to give trouble. A remarkable feature is the manner in which the motor will perform its duty for years with the very minimum of attention.

The electric road vehicle enables a given weight of goods to be moved a given distance in the urban transport service at a cost which, for economy, is not reached by any other method. The automobile motor of to-day is compact, comparatively light in weight, and very efficient in the use of current. The standard motors are wound for 80 volts for use with the lead-plate battery, and for 60 volts for use with the Edison battery. Any departure from the standard of 40 to 44 lead plate cells, or 60 cells of the Edison type, is to be deprecated. The speeds for which electric vehicle motors are usually designed vary from 800 to 1,700 R.P.M., the actual speed in any instance being dependent upon the type of drive employed and the gear ratio selected.

In American automobile motors, the capacity is generally based on continuous operation at full load with a maximum temperature rise of 65 deg. C., and they are rated to carry two and a half times the normal full load for one hour with a maximum temperature rise of 75 deg. C. above the temperature of the surrounding air. The size of motor employed is that which will be loaded to its rated capacity when the vehicle is running at the normal rated speed on a hard level road and carrying the full load for which it is designed. Experience has shown that for commercial electric vehicles the "unsaturated" motor gives the best results, and this type is always employed. The use of the "saturated" type is confined to light passenger cars, where a higher speed on gradients is desired.

In America the large business connected with the manufacture of electric vehicles has been built up by co-operation between the firms constructing the vehicles and the electrical manufacturers. It is certain that automobile builders who are proposing to take up the construction of electrics will find it to their advantage to leave the manufacture of the motors, switchgear, and batteries in the hands of those who are already engaged in such work. Working upon such lines, there ought to be no difficulty in the way of any automobile builder taking up the construction of the electric, seeing that much of the chassis work is very similar to what he is already providing for petrol vehicles.

### DISCUSSION.

In the discussion that followed the reading of the paper it was generally agreed that the electric was essentially a short-distance, frequent-stop vehicle. It had its particular spheres of usefulness, and was not in any sense a competitor of the petrol vehicle. Several speakers expressed the opinion that the electric taxi-cab would be shortly re-introduced in this country. Surely if the present petrol cabs could be run at a profit in the very bad state they were in to-day, then the electric cab could be also run at a profit. With regard to pleasure vehicles the conditions were different. In America most towns were self-contained, and the vehicle was in consequence not required to go beyond the radius of the city. On the other hand, in this country pleasure vehicles were often required to travel long distances from town to town.

On the road, electrics seldom required attention, and they were practically weather and fool proof. During the recent snowstorms electrics had negotiated roads and hills quite safely where petrol omnibus traffic was held up. In the garage, however, the electric required constant attention; nothing very serious, but it had to be constant and intelligent attention. It was merely a question of following certain rules and directions, and it was upon the attention received in the garage that the performance of the electric when on the road depended. Electrics were very simple to handle; women had driven large 2½ and 3½-ton vehicles after very little tuition. Repairs could be easily and quickly carried out, whereas repairs to petrol vehicles often involvel dismantling the engine, and took much time. The danger of judging electric vehicles by operating costs was pointed out. Such costs could be very misleading at times, because the conditions under which vehicles operated varied so very much. The safest thing to go by was the opinions of actual users. It would be found that in all cases where firms in this country had adopted electrics on a sufficiently large scale the results were favourable; in every case the fleets had been added to.

With regard to batteries, there was very little to choose between the two leading types; good results were obtained with both. A speaker pointed out that there always seemed to be a doubt about the capabilities of a modern high-class battery. The public always seemed to be afraid of batteries, and all makers conveyed the impression that there was some sort of secret about them. There was really no such thing; it was all a matter of ignorance. If the public could be taught exactly what a battery was, and just what it was capable of doing, the whole thing would become perfectly straightforward.

With regard to the high cost of electric vehicles, those imported into this country were naturally expensive on account of high freight. Those manufactured here would continue to be expensive until produced in sufficient quantities to lower the cost of manufacture. To those petrol or steam vehicle manufacturers who contemplated taking up the manufacture of electrics a note of warning was given. Although it was agreed that it would be to their advantage to manufacture such vehicles, they should do so in conjunction with other firms, and not attempt to make everything themselves. For instance, such specialities as control gear, electric motors, and batteries should be left to those firms whose business it was to make and specialise in such things. Electrics had suffered much in the past owing to some defect in a component part of the whole which could have been produced much more satisfactorily by a specialised maker.

## LARGE POWER TRANSFORMERS.

AT Manchester, on March 11th, MESSRS. A. G. ELLIS and J. L. THOMPSON'S paper (an abstract of which appeared in our issues of May 9th and 16th) was read and discussed before the NORTH-WESTERN CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS.

Mr. H. G. FURLONG did not agree that opportunities had not been afforded to manufacturers for making large transformers in this country; there had been, and still were, such opportunities, but manufacturers frightened customers by describing the imaginary difficulties of designing and making large units. There was no reason why three-phase transformers should not be made in single units of the same capacity as turbo-generators. The transformer would occupy less space, the total weight would be much less, and the capital and running costs would be lower than with a group of small sets. It should be more reliable. Transformers above 5,000 K.V.A., 50-period, 3-phase, should certainly be forced-cooled. A thermostat could be fitted to warn the attendant in the main station, or to operate the switch relay and cut the transformer out of circuit. The core and the circular shell-types had great advantages over the shell type, as the coils were in direct contact with the oil. In the core-type it was a simple matter to arrange straight oil ducts of ample size so that they could be easily cleaned without dismantling. The authors' contention that the shrinkage of insulation on a shell-type was less was not convincing. The assumption that the shrinkage was entirely due to pressure was not correct. The electromagnetic inter-action of the primary and secondary coils produced pressure on the insulation due to the repulsive action between the two windings, and this was the principal cause of shrinkage. The compression stresses were in many cases greater than the stresses due to the weight of copper in the core-type transformer. The slightest amount of shrinkage was of great importance, and should in some way be taken care of. Insulation had been one of the greatest problems to transformer manufacturers during the war, but fortunately it had now been practically solved by the larger firms installing their own plant and manufacturing insulation suitable for their requirements. Springs should not under any conditions have to take the electromagnetic strains, but should only take up shrinkage and hold the coils against fixed abutments. The electromagnetic strains should be taken by the fixed abutments; consequently the only satisfactory way of using springs was to divide the coils at the magnetic centre and place the springs there. The safety factors given were quite reasonable. If all engineers would work to the British Standard Rules and not subject their transformers to overloads under any condition, these safety factors could be reduced, the prices lowered, and the design improved. He was surprised the authors had omitted to mention furnace transformers. He had been responsible for the design and manufacture of numerous furnace transformers ranging from 150 to 10,000 K.V.A., some were shell-type, others core-type, and they were equally satisfactory.

Mr. G. D. SILLS said that the importance of drying out transformers was not usually recognised by the purchaser, and it was quite impossible to dry out on site as thoroughly as it could be done in vacuum in the works. The amount of air, or rather space, which should be available round transformers was often overlooked. He had seen three sets of transformers, at three different stations, actually placed in pits. There had been dissatisfaction with water cooling, but he thought it had often been because the right material had not been used for the pipes. The proper thing to use was lead alloy, which could be bought in one piece, and could stand up to 250 lb. pressure, which was quite ample. Moreover, comparatively impure water

could be used. On the question of stations being in out-of-the-way places, it seemed to him it would be much better to put in smaller self-cooled units. No mention had been made of the building cost. In a large station with modern three-phase transformers a considerable amount could be saved in the building. It seemed to him the authors had made out a very good case for the shell type, but he thought that a better case could be made out for that type with butt joints, because of the ease of assembling; bracing could be done in a much more satisfactory manner than with interlaced joints. The previous speaker's remark about the coils in the core-type being in direct contact with the oil was rather misleading. There was no layer in direct contact with the oil, but in most cases one had to transmit heat through two or three layers to the oil itself. With a well-defined shell-type transformer one could certainly have oil on at least one side for the whole coil—what might be called the pancake coil—and on the heavier coils it could be arranged to have oil on both sides of the coil. If the transformer was properly designed, and the depth of the coil made not more than, say, twice its thickness, the heat could very soon be got rid of. It seemed to him that electrical gear was now becoming a problem of mechanical construction. He agreed that too many transformers were bought without considering their construction. An apparatus had been made in this country, and was now in operation, for testing transformers up to half a million volts; it had actually done up to 475,000, and it was of 200-K.V.A. capacity.

Mr. CRIDGE explained that his experience was that less than 10 per cent. of transformers were shipped in oil; if that proportion could be increased it would be a very good thing. The railway companies had raised objections lately to shipping transformers in oil, or in tanks without oil, except at owners' risk. The authors had not made quite enough of the superiority of forced-cooled over water-cooled transformers of large size; they did not mention the increased size of transformers which could be put in the same tank. He hoped that the British Engineering Standards specification would be adopted; if every customer adopted it manufacturers would be compelled to follow. Referring to the authors' load curves, he pointed out that somebody should design a meter which would register the kilo-ampere-hours instead of the KW.-hours, in order that such loads might be charged for in the proper way. In his opinion, bracing could sometimes be overdone; with the rectangular shell-type coils serious distortion might take place at the end of such coils. A little freedom in that respect was desirable. The continental practice had been to use butt joints almost exclusively. Constant temperature was not reached until much later than was thought to be the case. One degree rise per hour was sometimes considered to be near enough to the final temperature, but it was not anything like constant. The only cure for sludge was to use a liberal amount of the best possible oil, and the transformer should not be allowed to overheat.

Mr. WATSON said that, speaking generally, transformers gave far less trouble than any other apparatus handled in connection with supply problems. The fact that at 25 cycles transformers were 35 per cent. more costly and 40 per cent. heavier than they were at 50 cycles had not been driven home. He imagined it was more likely to become the practice to adopt single-phase rather than three-phase units in very large sizes by reason of the convenience and lower cost in providing spare units for use in an emergency. Three single-phase units would occupy a larger space than one three-phase unit, but in the majority of generating stations he did not think there would be much difficulty in providing that space. It added considerable value to the paper that a comparison of prices was given. In the past it had too often been a fault that different types of apparatus had been discussed without information being given as to costs. Pumps, oil tanks, and circulation arrangements, in connection with large units, led to appreciable expense, and it was not clear from the paper whether that was included or not in the prices given. Something required to be done in regard to the standardisation of sizes of transformers.

Mr. WILLIAMS agreed as to the advantage of transporting in oil, but that was not to be recommended for foreign shipment. There appeared to be a discrepancy with regard to the "crocodile" trucks which were said to be available in this country up to 50 tons loading weight. The authors seemed to assume that a transformer in a truck must be transported vertically. He had a strong liking for the shell-type transformer on account of its robustness. Personally, he had a decided preference for the single-phase as against the three-phase unit, particularly when it was of large size. One point which had not been brought out was that if a serious breakdown occurred in a three-phase unit the probability was that it would completely wreck the whole transformer, and the cost of rewinding was considerably greater than it would be with a single-phase unit. The water-cooled transformer of the cooling-coil type was a very poor device. With water cooling it was essential that the water should be at less pressure than the oil, so that if there was any leakage it would be from the oil to the water; he did not see how that could be satisfactorily done with the water coil at the top of the transformer.

Mr. H. T. S. BINNS said that most of the points on which he disagreed had been covered by previous speakers. A great claim was made for the robustness of the shell type. A close study of the construction would show that the only means of support for the coils was the crossbar, since the clamps shown under running conditions did not come into play at all. Immediately shrinkage took place these clamps—which the authors particularly drew attention to, but which were not intended for taking up shrinkage—were no longer of any service. He suggested as a test of robustness that the experiment of hanging the transformer by one ring bolt instead of two should be made, when it would be found that very considerable distortion would result. He had seen a transformer weighing 14 tons, three-phase, core-type, hung up by one side only, and no distortion whatever took place. It had been mentioned that external supports with the rectangular shell-type were unnecessary, but he had seen a transformer of this type where the coils had burst and short-circuited.

Mr. J. F. SHIPLEY said that the item of "woman labour" could be omitted from the summary of the paper. Transport restrictions were not mentioned, except the restriction of the import market in materials. He found there was nothing much to grumble about except the packing. Generally it received attention from the chief packer, never from the engineer. If manufacturers would get their engineers to design the packing a great improvement would follow. Shipping transformers in oil, complete, could be done very well when shipping from one big port to another, but where it was necessary to tranship or unload at sea separate packing cases had to be used for everything.

Mr. W. PARRY said that some information with regard to transport along the roads on trucks, and also relative to furnace transformers would be useful. The suggestion that lead-alloy pipes could be put in parallel applied to copper pipes as well, getting rid of the joints in a similar way. With regard to failure of large transformers on the Rand, it was found that the pipe used had not been extruded correctly; there were patches in the walls owing to crude water, which had run right through and affected the transformer. That point should be watched. Oil could be circulated along both sides of the coil in the shell type, but not in the core type. Most of such coils were wound two sections together, separated simply by a washer, but the oil had free access to one side of each coil. In order to get the oil on both sides, the sections would have to be split up again into two separate coils, thereby wasting nearly twice as much space in ducts. That was entirely unnecessary, because the conductivity of the copper across that small space was quite sufficient to prevent any temperature drop. The same thing applied to core types of transformers, but there the spaces between the coils were radial; consequently, the sludge could be easily cleaned out, which could not be done on the shell type.

Mr. ELLIS, replying to the discussion, said that in connection with the question of the shell-type *versus* the core-type, the discussion of the relative merits was usually prejudiced by the particular views and experience of individual manufacturers and power supply engineers. He had not been wholly converted to the shell type, but in writing the paper the point of view was to get down to an impartial statement of the facts, and that they had really tried to do. The time was opportune for a general and fair statement of all the facts concerning transformer design and operation, and the main object in writing the paper was to bring that under discussion. The prices given in the paper were present-day prices; they were only given for guidance. The prices given with regard to the forced-cooling transformer included the full equipment. Mr. Sills referred to a device which prevented sludge. That controversy had lost much of its interest owing to people realising the importance of having a decent non-sludge oil, and not a cheap variety, such as was probably the reason for the oil-expansion chamber being originally invented. If they had included in the paper everything that everybody had called for they would have written an encyclopædia. He hoped at a future date to be able to deal with other questions. In view of the inter-linking questions which were coming on, they gave at the end of the paper sufficient indications of the general lines on which they should attack those problems. They deliberately left out furnace transformers. The paper was intended to be written from the point of view of a large central station, and the question of furnace transformers merited complete treatment by itself.

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**Industrial Lighting.**—It is estimated that, in the United States alone, accidents due to poor lighting rob industries of the services of more than 100,000 men for an entire year. During recent years, increased quantity of light has been used in industries, but there has not been the same progress in the use of suitable reflectors or other light-directing devices. Nevertheless, the proportion of industrial accidents chargeable to poor lighting has fallen from 25 per cent. in 1910 to 18 or 20 per cent. in 1918. Industrial lighting curtailment as a measure of economy is based on a fallacy, for the resultant decrease in production and increase in accidents far more than counterbalance the saving in energy consumed by lighting.

**British Oil.**—The oil borings by Messrs. Pearson, Lord Cowdray's firm, near Chesterfield, are progressing. At the Hardstoft No. 1 boring, a depth of 2,800 ft. has been reached, and the indications are regarded as favourable. The next deepest boring is Brimington No. 1, 1,800 ft., and a flow of natural gas gave rise to a rumour that oil had actually been found. Two other borings have been started in Staffordshire.

# THE SUPPLY OF ELECTRICITY.

By J. S. HIGHFIELD, M.Inst.C.E., M.I.E.E.

*(Abstract of paper read before the* Royal Society of Arts.)

The recent publicity given to the subject has led the public to look for great reductions in prices and many other benefits to accrue from the Government taking charge of the industry. With the present cost of plant, fuel, and labour no startling reductions in price can be looked for. Having regard to cost of production, electricity is now supplied in all industrial districts and large towns at cheap rates, the figures in the following table being typical of average prices:—

TABLE I.

| Name of town. | Maximum load. | Cost per unit exclusive of capital charges. | Average price received per unit. | Percentage of gross profit to capital. |
|---|---|---|---|---|
| | kw. | d. | d. | d. |
| Ashton-u.-Lyne... | 2,636 | 0·55 | 0·85 | 7·50 |
| Birmingham ... | 54,930 | 0·91 | 1·28 | 9·46 |
| Bury ... ... | 5,128 | 0·55 | 0·82 | 8·10 |
| Glasgow ... ... | 55,610 | 0·83 | 1·21 | 8·35 |
| Leeds ... ... | 24,920 | 0·52 | 1·04 | 8·31 |
| Liverpool ... | 29,048 | 0·76 | 1·51 | 10·41 |
| Sheffield ... ... | 57,338 | 0·48 | 0·88 | 13·36 |
| Stalybridge ... | 9,000 | 0·45 | 0·82 | 11·37 |
| City of London... | 21,000 | 1·55 | 2·55 | 7·01 |
| Cty. of London Co. | 18,500 | 1·42 | 2·19 | 7·14 |
| London Co. ... | 23,300 | 0·80 | 1·06 | 4·36 |
| South London Co. | 4,350 | 1·12 | 1·92 | 6·87 |
| South Met. Co.... | 9,800 | 0·96 | 1·51 | 8·19 |

Unfortunately, there is no simple means of measuring the cost of supplying electricity to enable a ready comparison to be made between one method and another or between the costs of one station and another.

Table I shows what wide variations exist in the working cost per unit sold and the average price received for electricity. Any use of either figure for the purpose of comparing the general excellence of these undertakings would be wholly erroneous.

The smaller profits earned by the companies are noticeable. One of the main reasons is, that in nearly all the company areas there is a second competing company, with the result that large unnecessary capital and other costs are involved. In the municipal areas there is no competition. A second reason is the large capital sums spent by the companies on pioneering work.

The reasons for the large variations in the costs and in the selling prices are to be sought in the existence, or otherwise, of competition, in differences in the price of coal, the number of consumers, their average load, and the use made by each consumer of electricity.

The total capital charges usually represent about 50 per cent. of the total cost of supplying a consumer with electricity. The average cost of connecting a consumer, including the service, meter, and proportion of the distribution main, is about £25. The coal bill represents about 25 per cent. of the total charges to the consumer, and the other charges the remaining 25 per cent.

The incidence of the above charges varies with the class of load supplied, as follows:—

| | |
|---|---|
| Total capital charges ... | ... from 30 to 60 per cent. |
| Coal ... ... ... | ... from 55 to 10 per cent. |
| Other working expenses | ... from 15 to 30 per cent. |

The first figures represent approximately the ratio for undertakings supplying a small number of large consumers with a high load factor, and the latter figures undertakings supplying a large number of small consumers. Of the total, the items that vary in approximate proportion to the output in Board of Trade units consist in an amount represented by the cost of three-quarters of the coal and stores, with a proportion of the repairs and wages, or, say, 25 per cent. of the total cost of the supply. Consequently, if 100 represents the total cost of working a particular undertaking at a load factor of 20 per cent., and if by reason of the consumers using their supply for longer hours they use twice the number of units, the total cost will be increased to 125. Therefore, the average cost per unit will be reduced by 37 per cent.

Having regard to the fact that the distribution capital represents approximately 50 per cent. of the total capital employed, and that the cost of transformation, distribution and maintenance of meters represents some 20 per cent. of the total cost, it follows that no decrease in the price of bulk supply by super-stations or otherwise can possibly result in a very large reduction in price to the ordinary small consumer. The ordinary consumer can effect for himself a reduction in the price per unit of much larger magnitude by making a better use of the supply.

In an ordinary private house, if the units used for lighting are about 300 per annum, the units used for heating and cooking will be about 3,000 per annum. Taking the price for lighting at 6d. per unit and the price for heating and cooking at 1d. per unit. the average price per unit would be 1.4d.

The recent high prices of coal and other fuel and the difficulty of obtaining supplies have resulted in a great increase in the use of electricity for heating and cooking, and, no doubt, had the apparatus for its use been readily obtainable, this increase would have been greater. There has also been a great increase in the use of electricity for power; the load factor has increased, and, in spite of the fact that new plant, when installed, has cost more than 50 per cent. above pre-war prices, that the price of coal, having regard to quality, has doubled, that wages and other expenses have increased two or three times, the electricity supply undertakings have been able to carry on and to make ends meet with a relatively small increase in price generally not exceeding 50 per cent. and with a smaller increase in the average selling price.

Had plant remained at pre-war prices, there is no doubt that progress in replacing small stations by large turbine stations would have been rapid. I set out in Table II the cost of power stations of small and large sizes. The figures are exclusive of the cost of land and are nearly twice the figures

TABLE II.—Showing Capital and Working Costs for Power Stations Erected and Worked at Present-Day Prices for Materials and Labour.

| Plant installed. | | Capital cost. | Maximum load. | Capital per kilowatt of load. | Load factor. | Units generated. | Coal consumption. | Running costs. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Cost of coal at 20s. per ton. | Other works costs. | 12½ per cent. on power station capital. | Total costs. | Per unit generated. |
| No. of Units. | Size of units. kw. | £ | kw. | £ | Per cent. | — | lb. per unit gen't'd. | £ | £ | £ | £ | d. |
| 2 | 250 | 28,100 | 250 | 112·4 | 25 | 547,500 | 5·0 | 1,230 | 1,070 | 3,500 | 5,800 | 2·54 |
| | | | | | 50 | 1,095,000 | 4·75 | 2,330 | 1,100 | 3,500 | 6,930 | 1·52 |
| 3 | 500 | 55,500 | 1,000 | 55·5 | 25 | 2,190,000 | 4·5 | 4,400 | 2,600 | 6,900 | 13,900 | 1·52 |
| | | | | | 50 | 4,380,000 | 4·25 | 8,300 | 2,700 | 6,900 | 17,900 | 0·98 |
| 4 | 1,000 | 125,650 | 3,000 | 41·88 | 25 | 6,570,000 | 3·5 | 10,250 | 5,900 | 15,700 | 31,850 | 1·16 |
| | | | | | 50 | 13,140,000 | 3·25 | 19,000 | 6,100 | 15,700 | 40,800 | 0·75 |
| 5 | 2,000 | 240,000 | 6,000 | 40·0 | 25 | 13,140,000 | 3·0 | 17,600 | 11,500 | 30,000 | 59,100 | 1·08 |
| | | | | | 50 | 26,280,000 | 2·75 | 32,200 | 11,800 | 30,000 | 74,000 | 0·68 |
| 6 | 5,000 | 535,000 | 20,000 | 26·75 | 25 | 43,800,000 | 2·5 | 48,900 | 21,000 | 67,000 | 136,000 | 0·75 |
| | | | | | 50 | 87,600,000 | 2·3 | 89,900 | 21,500 | 67,000 | 178,400 | 0·49 |
| 7 | 10,000 | 1,100,000 | 50,000 | 22·0 | 25 | 109,500,000 | 2·25 | 110,000 | 31,500 | 137,500 | 279,000 | 0·61 |
| | | | | | 50 | 219,000,000 | 2·10 | 205,000 | 32,500 | 137,500 | 375,000 | 0·41 |
| 6 | 25,000 | 2,142,000 | 100,000 | 21·42 | 25 | 219,000,000 | 2·0 | 195,500 | 53,000 | 268,000 | 516,500 | 0·57 |
| | | | | | 50 | 438,000,000 | 1·8 | 352,000 | 55,000 | 268,000 | 675,000 | 0·37 |

**The figures in the above table are merely typical. They may be expected to vary somewhat according to the locality and the site. They include estimated figures for buildings, wharfage, sidings, &c., but are exclusive of cost of land and of providing circulating water.**

obtaining before the war. I also show the approximate working expenses; these figures must be taken as typical; local conditions might produce wide variations. The figures show clearly the economy to be gained from the use of large plant.

TABLE III.—Showing the Cost of Transmission Systems at Present-day Prices for Labour, and taking Copper and Lead at £100 and £25 per Ton Respectively.

| Size of conductors and pressure. | | Useful capacity. | Capital cost per mile run. | Capital cost per kw. per mile run. | Working cost. | |
|---|---|---|---|---|---|---|
| | | | | | Per mile run. | Per kw. per annum per mile run. |
| *Underground System.* | | | | | | |
| Sq. in. | Volts. | Kilowatts. | £ | £ | 10 per cent. on capital. | £ |
| ·075 | 3,300 | 320 | 4,000 | 12·5 | 400 | 1·25 |
| ·125 | 3,000 | 540 | 5,000 | 9·3 | 500 | 0·93 |
| ·125 | 11,000 | 1,800 | 5,500 | 3·0 | 550 | 0·30 |
| ·125 | 22,000 | 3,600 | 6,000 | 1·7 | 600 | 0·17 |
| ·125 | 33,000 | 5,400 | 7,000 | 1·3 | 700 | 0·13 |
| *Overhead System.* | | | | | | |
| Sq. in. | Volts. | | | | 12½ per cent. on capital. | |
| ·075 | 3,300 | 320 | 1,300 | 4·0 | 162·5 | 0·51 |
| ·125 | 3,300 | 540 | 1,600 | 3·0 | 200 | 0·37 |
| ·125 | 11,000 | 1,800 | 2,060 | 1·15 | 325 | 0·18 |
| ·125 | 22,000 | 3,600 | 2,900 | 0·80 | 350 | 0·10 |
| ·125 | 33,000 | 5,400 | 3,200 | 0·6 | 400 | 0·08 |

Two cables and six overhead wires are included in each line to work with three-phase alternating current.

In Table III I show the cost of underground and overhead transmission lines, the cost of the latter varying from less than one-half to slightly over one-third that of the former. The figures in the last column show that under the best conditions the cost of transmission for distances exceeding 20 miles is a serious item. It is clear that the increased cost of plant and mains must mean that the superseding of existing plant will be delayed.

Often the argument is advanced that State or municipal ownership results in low prices. Before the war, companies were able to raise loans at rates of interest varying from 3½ to 4½ per cent.; municipalities in general paid from 3 to 3½ per cent., or, say, some 1 per cent. less; but under the terms of the loans they were obliged to provide sinking funds to redeem the loans in about 25 years, involving a sinking fund of from 3 to 3½ per cent. In place of a sinking fund, the companies usually apply to depreciation and reserve an amount equal to about 2 per cent. of the capital; consequently, so far as the loans are concerned, the total annual payment for money so raised is approximately the same as for municipalities.

The companies also raised considerable sums of money by the issue of preference shares entitled to dividends at the rate of from 5 to 6 per cent.; the money so raised thus cost, after allowing for depreciation, perhaps one-half of 1 per cent. more than the money raised by the municipalities. Something like one-half of the total capital of the companies has been raised by the issue of ordinary shares, and average dividends have been paid thereon of approximately 4 to 5 per cent.

The matter may be examined by comparing the gross profit earned by the company and municipal undertakings. The figures, extracted from "Garcke's Manual of Electrical Undertakings," are as follows:—

TABLE IV.—Amounts of Capital Expenditure and Gross Profit in certain Company and Municipal-owned Electricity Undertakings.

| Year. | No. of undertakings. | Capital expended. | Gross profit before providing for depreciation. | Percentage of gross profit to capital. |
|---|---|---|---|---|
| | | *Company Undertakings.* | | |
| | | £ | £ | % |
| 1914 | 98 | 25,132,662 | 1,722,396 | 6·8 |
| 1915 | 95 | 26,281,952 | 1,686,389 | 6·4 |
| 1916 | 93 | 25,958,683 | 1,673,552 | 6·4 |
| 1917 | 111 | 27,107,746 | 1,914,634 | 7·0 |
| | | *Municipal Undertakings.* | | |
| 1914 | 186 | 45,250,532 | 3,653,919 | 8·0 |
| 1915 | 199 | 49,424,226 | 3,952,902 | 8·0 |
| 1916 | 180 | 49,375,009 | 3,830,077 | 7·8 |
| 1917 | 172 | 49,246,295 | 4,054,771 | 8·2 |

The main reason for the difference in gross profit is that the companies in general supply under more difficult conditions than the municipalities. The latter supply nearly all the large manufacturing towns excepting Newcastle and London, and in the latter there are over all the dense central areas competing companies, and in the county areas of the power companies difficult distribution problems have to be faced.

There is no doubt that had the prices charged to the consumers been increased by even 1 per cent., and had the additional profits been applied to improving methods and apparatus, the cost to-day to the consumer would have been less. Whatever is ultimately decided upon for the future conduct of electricity supply, it is to be hoped that at least the finances of the industry will be arranged so that there will be such a margin over and above the cost of production, including the capital charges, as will provide an ample reserve not only for the replacement of plant as it becomes obsolete, but also for the conduct of large-scale experiments, directed to increasing efficiency and improving methods. The existence of profits and the expenditure of a sufficient sum for the above purposes is the only way to establish the business on a really firm foundation, and is the surest way to provide for the production of electricity at the lowest possible price.

Financial assistance from the State for industry may be, in certain cases, necessary and justifiable, but such assistance should be rendered only when absolutely necessary. Experience shows that electrical supply is a stable industry, and although the margin of profit has been small in the past, in the sense that the ordinary shareholders of companies have received an average dividend of only 4 to 5 per cent., the business is one that should offer a safe investment for capital, and in the future there should be no difficulty in raising dividends to 8 or 10 per cent. The power companies raised large sums of money, and after earning very small profits for some years they are gradually improving their position, as the following figures show:—

| Year. | No. of companies. | Capital expended. | Gross profit. | Capital. |
|---|---|---|---|---|
| | | | | Per cent. |
| 1910 | 6 | 6,246,322 | 249,728 | 4·0 |
| 1913 | 7 | 7,461,917 | 374,684 | 5·0 |
| 1917 | 8 | 10,495,454 | 723,640 | 6·9 |

They have now established themselves, and there is no reason why they should not become increasingly prosperous commercial undertakings, able to raise through the ordinary channels the money they require for development.

Again, the larger municipal undertakings showed in the year 1917 an average return on the capital expended of 8 per cent., and in addition to meeting the whole of the interest and sinking fund charges, they were able to set aside for reserve a sum of £414,818 on the total capital sum invested of £49,246,295.

From these figures there does not seem to me to be any strong case for State assistance, so long as the development of electrical supply proceeds along well-trodden lines.

Development should proceed outwards from the towns. With this object a uniform system should be adopted so that, when eventually the call for power increased in the intermediate districts, the supplies could be linked together so as to form a uniform and complete system.

The chief saving of coal is made by changing from an isolated plant to a central electrical supply. The individual plant may use as much as 12 tons of coal per kw. per annum, as against 4 tons at a central power station. Before putting down independent plant, it is to be regretted that consumers often fail to realise that, although the immediate comparison may show some small advantage in its favour, the ultimate advantage is all in favour of the central supply of power, as once the private plant is installed the cost of power cannot be reduced until the plant is finally scrapped at the end of 15 to 20 years; in fact, as the plant gets older the cost of running it tends to increase. Against this fixed cost, the tendency of the central station is to reduce continually its costs; its load is always growing, necessitating the installation of new plant, which is invariably more economical than the old plant. The skill and attention given to the plant tend to increase as the plant increases in size, resulting in a steady decrease in the cost of production and in a lower price to the consumer. Every new customer of a central station reduces the incidence of the standing charges, and enables the date for erecting new and more economical plant to be advanced.

The most satisfactory method of financing a power undertaking is for most of the consumers to have some direct financial interest in its success. The prices for power should be so fixed as to produce an ample return on the capital, so that sufficient amounts can be set aside to provide for the early scrapping of uneconomical plant, for the adoption of the newest methods, for research in the methods of using fuel, and for the payment of, say, 8 to 10 per cent. on the ordinary capital. A company so situated would be able to raise money at the lowest market rate of interest; the fact that its consumers are interested in its prosperity will make them most excellent canvassers, so that the business should increase rapidly; with every increase in business its costs will tend to decrease, and, consequently, its profits will increase, and should be shared with its consumers before the rate of dividend is increased above, say, 8 per cent., and as the dividend increases the proportion of the profits distributed among the consumers by way of a reduction in price should be increased.

It is probable that in the near future further progress will be made in the electrification of railways. Stations should not be put down by railway companies but by the electric supply authorities, and should form part of their main systems.

The depreciation in the currency and the consequent advance in the prices of plant, wages, and material have, from an economic view point, delayed the date for scrapping existing plant, and have made the conservation of capital of the first importance. On the other hand, the increased cost of

coal and the necessity for conserving it, are pressing reasons for taking care that future developments make for the maximum of economy. It is clear that the artificial boundaries that have hitherto confined each undertaking to its district should be bridged over. It is almost certain that the plant available to-day will be, from the point of view of economy in coal consumption, obsolete within the next fifteen years. There is the less reason to plunge rashly into huge expenditure far ahead of requirements.

When the Government takes under its wing any enterprise, it should take care that in making laws for its conduct the ordinary principles of business should be observed. The law should enable the business to flourish, instead of making the earning of profit difficult or impossible; it should protect the industry so that ample profit can be earned; large reserves should be encouraged, and increasing profits shared with the customers; thus only can the widest expansion and the lowest prices be attained. If direct State aid is required at all it should be resorted to only when other methods fail.

It is of the utmost importance that the present uncertainty should be removed as soon as possible; it is hampering the industry just at a time when confidence is of the greatest importance. Extensions of plant are called for in every direction, and delay will lead to breakdowns and shortage of supply. Naturally, in the present uncertain position, doubtful if their property is to be transferred to rather nebulous district boards yet to be set up, and, if so, at what price, both companies and municipalities hesitate to embark on new expenditure. Any long delay will do far more harm than the district boards can put right for years.

## DISCUSSION.

Mr. JAMES DEVONSHIRE said he was responsible for the first Parliamentary promotion of a Power Bill, viz., in 1898, when the General Power Distributing Co. endeavoured to obtain powers to supply electricity over a very wide area. The Bill passed through the House of Lords, but failed in the Commons, where it met with a solid phalanx of opposition from the municipalities. However, he did not think that the £10,000 expended was wasted, because two years later there came before Parliament a group of power bills, all of which received Royal Assent. Moreover, he believed the promotion of 1898 was responsible for the appointment of Lord Cross's Committee, which recommended that electricity should be authorised for distribution over wide areas.

Mr. G. W. PARTRIDGE, as one of Mr. Ferranti's assistants, described how supply was given in the old days, from overhead cables at a pressure of 2,400 volts, with house transformers. Mr. Ferranti was 20 years in front of everybody else. The original 10,000-volt cables were in actual use over a great portion of the London company's system to-day—about 28 miles of these cables. The controversy between alternating and direct current in the early days was so keen that the respective managers would not speak to one another. With regard to the superstations which were so much talked of, for every pound of coal burned it was necessary to have 500 lb. of water for condensing purposes; the question of circulating water was of the greatest importance. If they could make use of the large heaters of which so much was heard, the load factor would be very much improved, and the customers using them could have energy at a very low rate. During the war certain countries, such as Italy and Switzerland, found it practically impossible to obtain coal even at £10 or £12 per ton; the Swiss were so short of coal that they had to make use of these large heaters, and at the present time he understood that there were no fewer than 47 different types of these heaters in use or being completed.

Mr. L. L. ROBINSON said that his Council, upon his advice, had departed from the old and stupid municipal habit of condemning everything that a company did. The Hackney Borough Council had linked its power station with that of the North Metropolitan Power Co. with the view of obtaining the greatest advantage out of the two systems for the purpose of munitions manufacture in the north-east of London. That was done by running a cable from a sub-station in the north of Hackney to a sub-station supplied by the North Metropolitan Co. in Stoke Newington. That cable had been used throughout the war, and it was being used constantly to-day, for keeping the loads on the respective works at economical figures. Hackney now never ran its works unless there was a load sufficient for a big turbine, and the whole week-end was dealt with by the company. The saving had been most striking. Before they linked up, Hackney was using 3 lb. of coal per unit, but now it was less than 2¼ lb.

Mr. W. L. MADGEN said that one of the most serious difficulties with which the electrical industry had had to contend in the past was the competition of private generating plant. Up to the time of the war the number of private plants which were being installed had gradually diminished, but the uncertainty as to legislation affecting the industry was not only having an influence upon extensions of the large power stations of the country, but it was also unsettling the minds of the owners of large works, with the result that there had been a very large increase in the orders for private plant. He was informed that of the electrical plant now on order, one-third was for private installations. Notwithstanding the greatest pressure being brought upon the authorities to do something quickly, months had gone by, and still there were no signs of action. Meanwhile the industry was suffering very severely.

Mr. P. D. TUCKETT said he could not quite agree with Mr. Madgen as to the position with regard to private plant. His own impression was that the tendency to install private plant was still diminishing where the power companies were in a position and willing to supply. At the same time, in the present uncertain state of legislation, the supply industry did not know where it was, and hesitated to spend large sums of money in pushing the sale of power among large manufacturers.

Mr. C. A. BAKER said that in the discussion on the recent paper at the Royal Society of Arts by Sir Dugald Clerk, a comparison was made between cooking by gas and cooking by electricity. In such comparisons it was important that electricity should have fair play. The speaker in question said that 100 units used in a modern electric cooker were equivalent to 1,000 cubic feet of gas in an old-fashioned gas cooker. He had with him some figures from one of the L.C.C. cooking schools in which gas and electric cookers were side by side, and the staff were free to use either as they thought fit. Thus the figures were unbiased. The gas required to cook a dinner consisting of 4 lb. 1 oz. of beef, boiled potatoes, greens, and an apple pie cost 1.26d., whilst electricity to do the same cost 1.4d. With gas cooking the joint was reduced in weight by 12½ oz., and with electricity it was reduced by 7½ oz. The total cost of cooking by gas worked out at 9.86d. and by electricity 6.55d., and the comparison was that 39 units of electricity were the equivalent of 1,000 cu. ft. of gas, or 100 units the equivalent of 2,580 cu. ft. of gas.

Mr. G. L. ADDENBROOKE said that as one of the old pioneers he was alarmed at the attitude which the public was taking up towards the whole question of electricity. There seemed to be a sort of idea that if the Government took over electricity supply every farmer within five miles of a town could have electric light in his farm buildings, motors, &c., and that every cottager in a remote district could also have electricity. There was no doubt, however, that the more the question was gone into the more it was seen that that would not be so, owing to the economical limits of distribution. Another point was that the erection of super-stations was entirely controlled by condensing-water facilities. If great advances took place which would do away with the need for these immense quantities of condensing water, in 20 years they would have all these costly super-stations lying in the wrong places, and a fresh start would have to be made. If the Bill were passed, it would take two or three years to prepare the plans, &c., and the stations would take a long time to complete, so that the industry would be in a state of uncertainty for the next five years, just at the time when reconstruction was very important, and when it was desirable that we should pull ourselves together as quickly as could be done. He hoped that sounder and more conservative counsels would prevail in high quarters in the future than seemed to have been the case in the past.

Mr. F. W. JENNINGS said that the advantage of using private plant when there was a large quantity of steam required for manufacturing purposes, had not been brought out very clearly. He was familiar with many private plants which had taken the place of supply from a public source in connection with which the coal bill for the factory had not been altered at all from that which was previously required for generating steam for factory purposes. Therefore, the only cost of the electricity was the interest on capital and depreciation. If that was developed a little more some of the smaller public supply stations might be used to better advantage than they were at present. Although the efficiency of a power station might only be 20 per cent., the combined efficiency, if the latent heat in the exhaust steam was made use of, was something like 60 per cent.

The CHAIRMAN (Mr. A. A. Campbell Swinton) said it was a surprising thing that electricity should have made the advance it had having regard to the difficulties it had had to contend with. All these difficulties had been due to political considerations. If the industry had had a perfectly free hand and the politicians had not been brought into the matter he was sure it would have been in a vastly superior position to-day than it was. If the authorities would only appoint technical people to attend to these matters and keep them out of the hands of the politicians, he was sure they would all be thankful.

Mr. HIGHFIELD, replying to the discussion, said the only deduction to be drawn from Sir Dugald Clerk's paper was that if the country was to save coal, the sooner electricity was got rid of and gas used instead the better. The answer to such a suggestion was that electricity was being used more and more every day for heating and cooking. The difficulties which would arise if new authorities were set up to purchase existing power stations and transmission lines could hardly, he thought, have been realised. Many of the existing smaller plants, which were erected when plant was much cheaper than it was to-day, were doing efficient service and supplying the consumer with cheaper energy than would be the case if they were scrapped under a national system and modern plant installed in their place at present-day prices. The difficulties of condensing water, which had been referred to, would be got over by putting power stations afloat, and in that connection use might be made of some of the German battleships. The difficulty of coaling would be greatly reduced, as colliers could be brought alongside, and ash handling became perfectly easy.

# NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

*Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.*

## An Electromobile Tipping Truck.

Storage battery industrial trucks suitable for use in warehouses, works, platforms, &c., are now coming into general use, and the following particulars of a truck fitted with a side tipping hopper, and made by Electromobile (Leeds), Ltd., Prospect Works, Otley, Leeds, may therefore be of interest. Our illustration (fig. 1) shows an A-type truck, the steel hopper having a capacity of 54 cu. ft. and the load being 25 cwt., that was supplied for carrying coal. The hopper, of course, tips both sides. The driving motor is of the well-known traction type, and the controller provides three positions for either direction, and is of drum type. It is contained in a metal protecting case, and the copper contacts, which are readily renewable, are so arranged that sparking is reduced to a minimum. Provision is made for the adjustment of the fingers. The controller is interlocked with the pedal contracting band brake, which acts on the propeller shaft, and is expanded clear of the drum as the driver mounts the platform and automatically applied as he leaves it, the controller handle returning to the neutral position. Steering is by lever with vertical movement, and the drive is by worm gear in conjunction with a full floating rear axle. Dust-proof housing is provided for the gears, which operate continually in a bath of oil; the worm is made

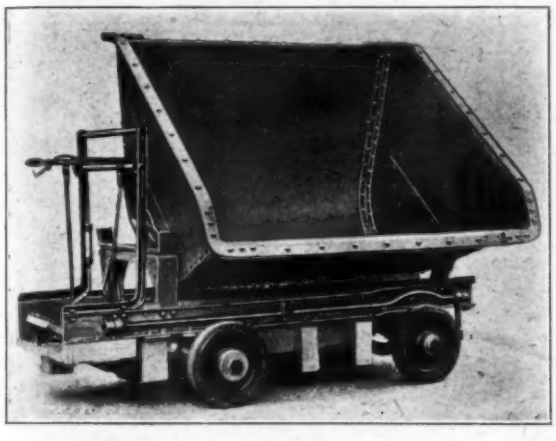

Fig. 1.—Electric Tipping-Hopper Truck.

of special alloy steel, and the worm wheel from phosphor bronze. The worm is mounted on ball bearings, of journal and thrust type, the differential carrying the worm wheel being mounted on similar bearings. Timker taper roller bearings carry the truck wheels. The wiring consists of English V.I.R. cable protected where possible by steel tubing and fittings. A fuse affords protection from misuse, and at the same time provides a simple form of safety key for preventing the truck being used by unauthorised persons. The standard battery equipment for this truck is 16 cells, I.M.V.5 Ironclad Exide, assembled in two trays clamped into position under the platform. This truck attains a maximum speed of 7 m.p.h. with a standard battery on a smooth level floor in either direction. It can be manœuvred in cramped positions at a speed of one or less m.p.h. The weight of A-type trucks is 1,900 lb.; length, 8 ft.; width, 3 ft. 4 in.; clearance, 4 in.; and the steering radius, 7 ft. It is stated that in some works these trucks are negotiating short grades of 1 in 6, and that on fairly level floors as many as six 1-ton trailers can occasionally be dealt with.

This firm manufactures all types of road vehicles, from ½ to 7 tons capacity, and also passenger cars.

## High-Pressure Discharge Apparatus for Wireless Telegraphy.

This ingenious device, invented by Mr. W. Hamilton Wilson, embraces a new combination of principles. After 18 months of exhaustive mathematical and experimental research it was put forward in 1914 for use in wireless telegraph transmitters for war purposes, and until the close of the war it rendered valuable service, many hundreds having been used by the War Office, Admiralty, and Royal Air Force under arduous active service conditions. Publicity during the war was carefully avoided, and public attention was not drawn to the invention until its mention in a lecture before the Institution of Electrical Engineers on April 3rd, 1919, by Lieut.-Colonel Cusins, R.E., on "The Development of Army Wireless during the War."

Fig. 2 shows the complete apparatus, and fig. 3 shows the electrical connections in one form of the invention.

When the signalling key (9) is depressed and the motor-driven interrupter (4) closes the circuit, for the first time, a charging current passes from the supply source (3) through the primary of the spark coil (2) to the condenser (7). The conditions of the circuits are made such that this charging current is oscillatory in character, and the timing of the motor interrupter can be made such that the circuit is interrupted when the charging current through the *supply source* is at, or near, zero value, and hence there is little or

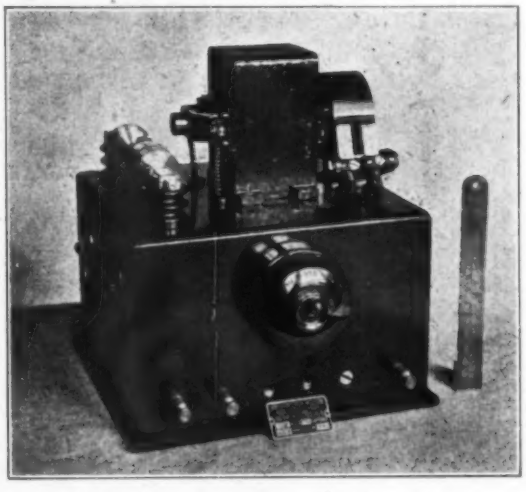

Fig. 2.—Wilson High-pressure Discharger.

no energy stored inductively in the circuits to produce a spark at the interrupter contacts at "break"; a simple interrupter without oil, gas, or spirit is all that is necessary. Further, since the break is made to occur when the oscillatory current is passing through its first zero, the condenser (7) is charged to approximately *twice* the voltage of the supply source, owing to its having been over-charged by the energy which was stored inductively in the primary (2) of the spark coil. A small magnetising current will have passed through the inductive winding (8) during the time when the interrupter was closed, but owing to the relatively high inductance of this winding and the exceedingly short time of

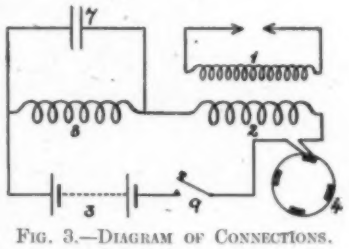


Fig. 3.—Diagram of Connections.

"make" the energy stored thus is quite negligible. When interruption occurs, however, the charge in condenser (7) oscillates through the inductance across its terminals, so that after the end of the first half period of this oscillatory discharge the condenser has become charged to the reverse sign.

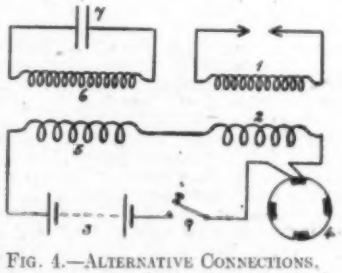


Fig. 4.—Alternative Connections.

The losses occurring during this reversal of charge are made small, so that the voltage of the reverse charge is still approximately twice that of the supply source, and the interrupter is timed to close the circuit for the second time at the moment when the reverse charge is a maximum.

Hence, it will be seen that immediately the circuit is reclosed there is a voltage of approximately three times that

of the supply acting round the circuit (due to the condenser voltage being added to that of the supply). This results in a greatly increased amplitude of the oscillatory current through the supply during the time when the circuit is closed for the second time; the condenser is discharging during the first quarter period of this current, and recharging in the opposite direction to a still higher pressure during the second quarter period of the oscillatory supply current, this direction being the same as at the end of the first "make" period.

Consequently, when the interrupter breaks the circuit a second time, namely, when the supply current is again passing through zero, the condenser will be charged to a voltage which may be approximately four times that of the supply, and this building-up or resonating effect will go on increasing until a discharge begins to pass at the terminals of the secondary (1) of the spark coil, or until the increasing losses in the system bring about a condition of equilibrium.

The spark coil behaves like a transformer—in fact, a closed-core transformer may conveniently be used in its place—and as the maximum pressure is impressed on its terminals at the instant when the interrupter closes the circuit, it follows that the secondary discharge takes place at that time. This may be shown, experimentally, to be the case.

For wireless transmitting purposes, the secondary of the spark coil is joined in the usual way to the high-pressure condenser of the high-frequency oscillating circuit.

In order that the condenser (7) may not be inconveniently large, and for other reasons, it is preferable to place this condenser across a suitable secondary winding having a large number of turns of what is termed a "buffer transformer." The most suitable manner of doing this is shown in fig. 4. The general principles given above apply also in this arrangement, but proof of the identity requires experimental or mathematical treatment.

Fig. 5 represents experimentally-obtained curves of current for fig. 4 when used with a condenser for producing high-frequency oscillations.

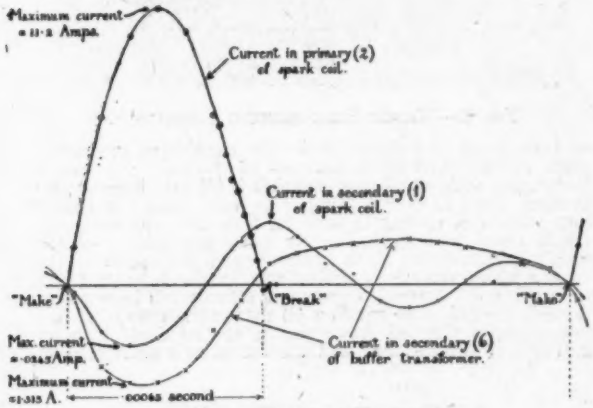
Maximum current = 11·2 Amps.
Current in primary (2) of spark coil.
Current in secondary (1) of spark coil.
"Make"
"Break"
"Make"
Max. current = 0·145 Amp.
Current in secondary (6) of buffer transformer.
Maximum current 91·315 A.
·00045 second

FIG. 5.—CURRENT CURVES.

The interrupter disk is rotated by a small direct-current motor at the correct speed. The brushes are easily renewable, and the disks have a long life owing to the freedom from injurious sparking. The sets can be made for any power input, within reasonable limits, that may be required, and for any supply pressure up to 500 volts. The maximum power input can be as readily arranged for low supply pressures, even down to 25 volts, as for the higher pressures.

Sets can be supplied to work at any given spark frequency, from 100 sparks per second to 1,000 per second. Standard sets operate at a spark frequency of 650 per second, which frequency takes advantage of the most sensitive telephone frequency. The spark gives a clear musical note, and enables reception to be carried on under conditions which would otherwise be impossible. It is claimed that the efficiency is exceedingly high, and may, under suitable conditions, exceed 75 per cent.

The patentee and sole manufacturer is Mr. W. Hamilton Wilson, of 4, Bank Broadway, Kingston Hill, Surrey.

## NEW PATENTS APPLIED FOR, 1918.

### (NOT YET PUBLISHED.)

**Compiled expressly for this journal by MESSRS. SEPTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.**

11,123. CONTROLLING AND REGULATING SYSTEMS FOR DYNAMOS OR MOTOR-STARTING SYSTEMS. W. J. Rickets. May 5th.
11,130. MACHINE FOR STARTING INTERNAL-COMBUSTION ENGINES, ELECTRIC MOTORS, &c. A. Danks. May 5th.
11,140. APPARATUS FOR MINE SIGNALLING, &c. J. R. L. Allott & E. Dean. May 5th.
11,168. PROCESS FOR ELECTRO-DEPOSITION OF COPPER ZINC ALLOY. S. O. Cowper-Coles. May 5th.
11,188. APPARATUS FOR INDICATING OPERATION OF IGNITION IN INTERNAL-COMBUSTION ENGINES. M. A. Leblanc. May 5th. (France, February 5th, 1918.)
11,192. ELECTRICAL RESISTANCE CONTROLS. A. H. Silcock & Tilling-Stevens, Ltd. May 5th.
11,301. RECEIVERS FOR WIRELESS TELEGRAPHY. H. J. Round. May 5th.
11,302. THERMIONIC TRANSMITTING DEVICES FOR WIRELESS TELEGRAPHY AND TELEPHONY. H. J. Round. May 5th.
11,306. GALVANIC BATTERIES. G. Oldham & J. Oldham. May 5th.
11,309. CONTINUOUS-CURRENT COMPRESSOR. E. A. E. Birk. May 5th. (Denmark, May 6th, 1918.)
11,234. ELECTRICITY STORAGE COILS. S. W. R. Potter. May 6th.
11,240. ELECTRIC CYCLE WHEEL ATTACHMENT. R. Cave. May 6th.
11,248. APPARATUS FOR HEATING LIQUIDS BY ELECTRIC RESISTANCE OR GAS. L. J. Simon. May 6th.
11,279. PORTABLE ELECTRIC PIANO-PLAYER. R. J. Martin. May 6th.
11,291. SWITCHES. K. C. Bass. May 6th.
11,303. ELECTRICALLY-HEATED SOLDERING IRONS. Soc. Calor. May 6th. (France, May 6th, 1918.)
11,304. LAMP FITTINGS. A. H. Midgley & Vandervell & Co. May 6th.
11,312. PROCESS FOR MANUFACTURING PURE ELECTROLYTIC COPPER FROM CEMENT COPPER. A. G. Sundberg & T. E. Thomasson. May 6th.
11,327. WIRELESS TELEGRAPHY. H. J. Round & G. M. Wright. May 6th.
11,332. ELECTROPLATING. C. A. Owen. May 6th.
11,338. RENEWAL OF FILAMENTS IN METAL-FILAMENT ELECTRIC LAMPS. S. Coxon and W. A. Williams. May 7th.
11,347. ELECTRICAL WATER-HEATING APPARATUS. J. F. Barr. May 7th.
11,348. ELECTRICAL WATER-HEATING ELEMENTS. J. F. Barr. May 7th.
11,387. ELECTRIC CONDUCTORS. A. G. Thornton. May 7th.
11,396. ELECTRIC WARMING AND VENTILATING APPARATUS. P. J. Ogle and H. Scott. May 7th.
11,397. ELECTRIC INCANDESCENT LAMPS. Renew Electric Lamp Co. & F. Harrison. May 7th.
11,408. SPARKING PLUG TESTER. H. Singer. May 7th.
11,427. CABLES FOR ELECTRICAL MACHINES. Electro-Agricultur Aktiebolaget. May 7th. (Sweden, June 7th, 1918.)
11,433. ELECTRICITY MOTOR METERS. J. Harris. May 7th.
11,436. ELECTROLYTIC GAS GENERATORS. I. H. Levin. May 7th. (U.S.A., May 22nd, 1917.)
11,460. OBTAINING SINGLE-PHASE ALTERNATING CURRENTS FROM EXISTING THREE-PHASE SYSTEMS. A. M. Taylor. May 8th.
11,466. ELECTRIC MUFFLE FURNACES. A. Imbery. May 8th.
11,480. MAGNETO-ELECTRIC MACHINE. E. Chawner & T. Wain. May 8th.
11,483. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. C. K. Shepherd. May 8th.
11,492. WATER COOLER AND ELECTRODE ECONOMISER FOR ELECTRIC FURNACES. F. G. Bell & L. T. Brearley. May 8th.
11,507. ELECTROLYTIC TREATMENT OF LIQUID GRANULATED OR SOLID SUBSTANCES. J. Colquhoun & J. T. Niblett. May 8th.
11,512. PROCESS FOR PRODUCING HARD RELIEF PLATE FROM DRAWING, PHOTOGRAPH, &c., FOR PREPARING ELECTROTYPED AND STEREOTYPED PLATES, RUBBER STAMPS, &c. A. E. Harris & A. Ward. May 8th.
11,514 & 11,515. SELECTIVE INDICATION, &c., SYSTEMS FOR OPERATION BY ALTERNATING OR PULSATING ELECTRIC CURRENTS. F. M. Lewis. May 8th.
11,523. SPARKING PLUGS, &c., FOR INTERNAL-COMBUSTION ENGINES. H. E. Dakin, Ltd., & F. H. Norris. May 8th.
11,536. INCANDESCENT ELECTRIC LAMPS. R. J. Burke. May 8th.
11,538. DYNAMO-ELECTRIC MACHINES. M. Chassin. May 8th. (France, May 8th, 1918.)
11,540. ELECTRICAL RESISTANCES. M. Perree. May 8th.
11,544. MAGNETO-ELECTRIC MACHINES. S. Evershed & Evershed & Vignoles. May 8th.
11,551. ELECTRIC LAMPS FOR MINERS. E. Lemaire. May 8th.
11,554. AUTOMATIC TELEPHONE LINE-FINDER SYSTEMS. W. Cross (D. S. Hulfish.) May 8th.
11,570. PROJECTOR ARC LAMPS. Johnson & Phillips & G. C. Pearson. May 8th.
11,578. HIGH-POWER THERMIONIC VALVES. S. R. Mullard. May 8th.
11,600. IGNITION FOR INTERNAL-COMBUSTION ENGINES. A. Lofthouse. May 9th.
11,648. ELECTRIC SIGNAL LIGHTS FOR MARINE AND AERIAL NAVIGATION. H. L. M. J. Benard. May 9th.
11,660. ELECTRIC SWITCHES. British Thomson-Houston Co. & E. B. Wedmore. May 9th.
11,661. SYSTEMS OF RADIO-COMMUNICATION. British Thomson-Houston Co. (General Electric Co., U.S.A.) May 9th.
11,666. ELECTRIC SWITCHES. H. K. Ansingh & British Westinghouse Electric & Manufacturing Co. May 9th.
11,679. ELECTRICAL RECEIVING APPARATUS. F. G. Creed & Creed & Co. May 9th.
11,682. ELECTRIC TRACTION MOTORS, &c. W. E. Ireland. May 9th.
11,687. MANUFACTURE OF INCANDESCENCE ELECTRIC LAMPS. F. Harrison. May 9th.
11,694. ELECTRIC ACCUMULATORS. E. Lemaire. May 9th.
11,741. WIRING TEST. E. H. Moline. May 10th.
11,759. ELECTRIC LAMPHOLDERS, &c. B.E. Co. & B. G. Harrison. May 10th.
11,762. RAY FILTER FOR CUTTING OUT HEAT RAY OF ARC LAMPS, &c. W. Mason & A. G. Newbury. May 10th.
11,767. ELECTRIC HEATING APPARATUS. H. J. C. Forrester (Burgess). May 10th.
11,789. ELECTRIC FUSES. J. T. Burden, W. J. Hawes & H. R. Rivers-Moore. May 10th.
11,800. ELECTRIC AND INCANDESCENCE LAMPS. S. Harrison. May 10th.

## PUBLISHED SPECIFICATIONS.

**The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.**

### 1916.

9,182. "Method and apparatus for directing artillery fire on moving objects." J. S. WILSON & W. E. DALBY. June 29th, 1916. (125,402.)
9,736. "Device for signalling secrets or otherwise by night or day for military or other purposes." R. A. HOUSTON. July 11th, 1916. (125,423.)
10,303. "Telegraph systems." AUTOMATIC TELEPHONE MANUFACTURING CO., R. WOODLAND & S. R. SMITH. July 21st, 1916. (125,434.)
11,014. "Screening or jamming systems for telegraph, telephone and other electric signalling systems." WESTERN ELECTRIC CO., G. H. NASH AND R. A. MACK. August 4th, 1916. (125,452.)
11,052. "Electrical signalling or indicating apparatus especially applicable for signalling orders and numerical data." E. A. GRAHAM. August 4th, 1916. (125,454.)
12,033. "Apparatus for wireless telegraphy." MARCONI'S WIRELESS TELEGRAPH CO. & J. ST. V. PLETTS. August 24th, 1916. (125,478.)
12,090. "Telegraph systems and apparatus therefor." AUTOMATIC TELEPHONE MANUFACTURING CO. & S. R. SMITH. August 26th, 1916. (125,480.)

### 1918.

5,810. "Negative plate substitutes for radio-photography." E. BURNETT. September 18th, 1918. (125,490.)
6,785. "Electric time switches." M. A. ABRAHAMSON, H. E. TVERMOES AND L. CHRISTAINSEN. April 22nd, 1918. (125,514.)
6,875. "Electric arc furnaces." F. H. A. WIELGOLASKI. April 24th, 1918. (125,516.)
7,957. "Control of power absorbed in electric furnaces." C. C. GOW AND D. F. CAMPBELL. May 11th, 1918. (125,522.)
9,104. "Electric motors." H. A. WHITESIDE. June 3rd, 1918. (125,531.)
9,582. "Incandescent electric lampholders or sockets." B. M. DRAKE AND DRAKE & GORHAM. June 11th, 1918. (125,533.)
9,592. "Method of controlling electric power transmission." H. B. EWBANK. June 11th, 1918. (125,534.)
13,130. "Railway signalling systems." MCKENZIE, HOLLAND & WESTINGHOUSE POWER SIGNAL CO. December 15th, 1917. (121,594.)
16,179. "Electric boat regulating switches." A. A. BUCK. March 11th, 1918. (124,185.)